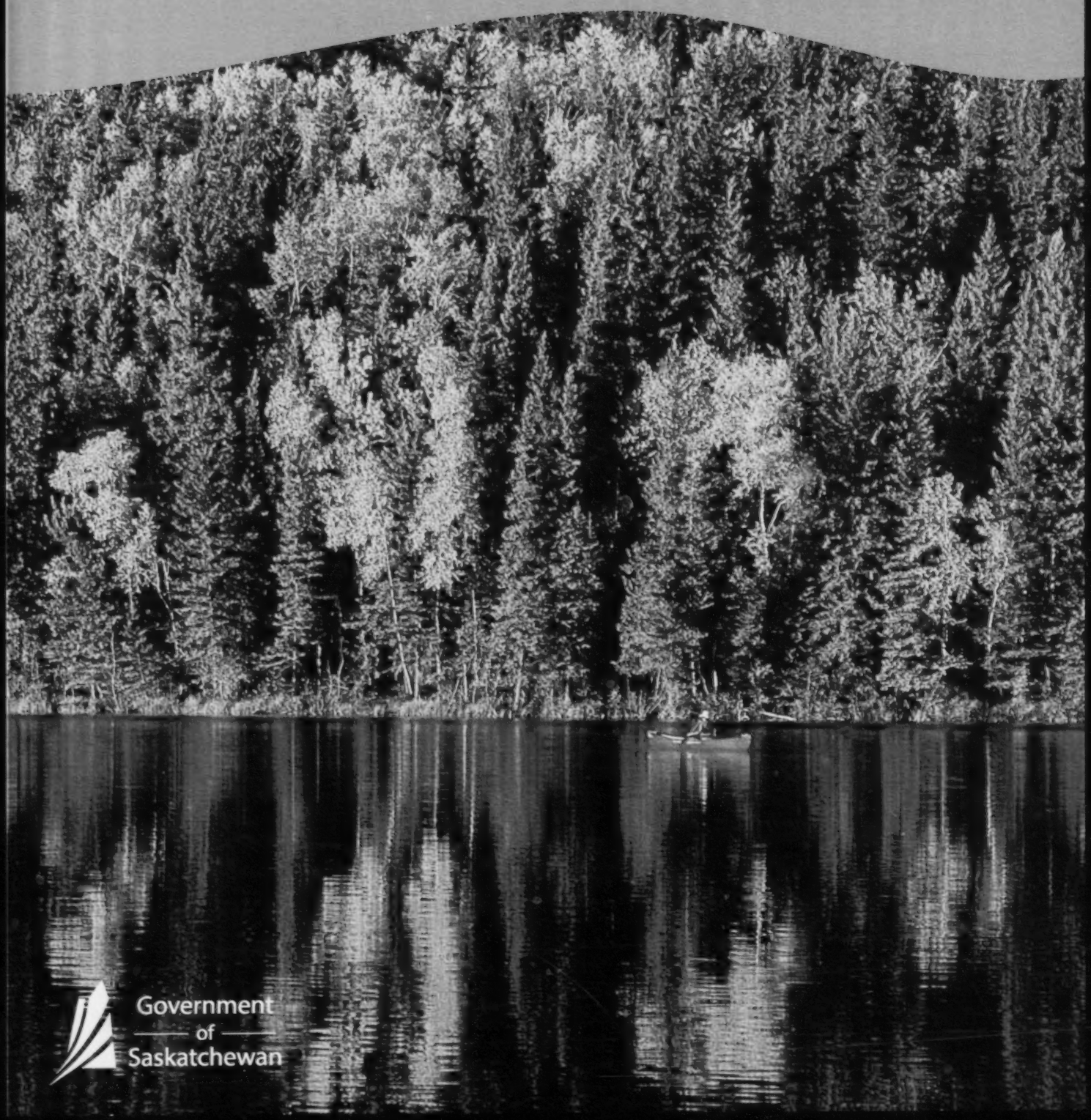
Saskatchewan's

2013 State of the Environment Report



Government of Saskatchewan

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Government of Saskatchewan

Minister's Message

In Saskatchewan, we enjoy a quality of life that is the envy of the world. The environment – our natural world and its interrelated components – provides its essential foundation. On behalf of the Government of Saskatchewan, I am pleased to present the *2013 State of the Environment Report*, the twelfth provincial assessment of the health of the environment.

This report builds on the framework established in the *2011 State of the Environment Report*, allowing changes to be tracked over time. As in 2011, it is organized around five major themes (Air, Climate, Land, Forest, and Water) and, under these, 17 diverse environmental indicators. The report also highlights local responses to environmental challenges, continuing a feature also introduced with the 2011 report. These inspiring stories demonstrate that environmental leadership has many sources, be it industry, business, communities, organizations or individuals taking constructive action.

The news is positive. This report finds that Saskatchewan's state of the environment is good. However, there are some areas that require attention. As our province and economy continue to grow, our approach to managing these challenges will influence the future condition of Saskatchewan's environment. Clear and accessible information will help everyone – government, business, industry, municipalities and households – to make good decisions. Our government remains committed to transparency and accountability, through clear reporting and improved public access to environmental information.

This commitment is supported as our government continues on the path of results-based regulatory reform, a shift from an emphasis on rules and permits to a system focused on important environmental results. In a results-based world, required outcomes are clearly defined and industry is responsible for achieving them. Innovation is encouraged, results are measured and opportunities for improvement are identified. State of the environment reporting will continue to have an important role to play as we assess the effectiveness of our environmental protection and resource management, and determine how we can continue to do better.

Like past reports, the *2013 State of the Environment Report* aims to provide an overview of the state of the environment, using the best and most current scientific information available. As we gain a better understanding of the environment and its health, we can take more effective action to manage and protect it. It is my hope that this report provides a part of that understanding.

Sincerely,

Ken Cheveldayoff
Minister of Environment

SoE

By the Numbers

The themes and indicators featured in this report provide a broad picture of Saskatchewan's environmental status and trends,and highlight ongoing efforts by government, industry, business and organizations to manage the province's resources and conserve its natural heritage. The following are a few examples of the report's findings and trends using the Condition-Stressor-Response model (described on page 5) for assessing environmental performance.

Condition

Saskatchewan has an abundance of space, fertile soils, and natural resources coupled with a relatively low human footprint. Cities are smog free, forests are healthy and productive and the environmental health of agricultural lands is improving

AQI 14-16

AIR QUALITY CONSIDERED EXCELLENT

overall in 2012 for Saskatchewan's major urban centres of Regina, Saskatoon, Prince Albert and Swift Current *(page 9)*

5.8%

SUMMERFALLOW

as a proportion of total farm area in Saskatchewan *(page 29)*

50%

of commercial forest

is considered mature to very old *(page 44)*

Stressor

The outlook for Saskatchewan's future is bright. Its population and economy are both growing and global demand for its resources is high. However, these changes will also increase the pressures on our air, land and water

Since 2007

30% or less

of the annual sustainable allowable cut was harvested each year *(page 51)*

132% increase in mineral dispositions from 2005 to 2011

High interest in Saskatchewan's mineral resources reflected by sale of sub-surface mineral leases *(page 31)*

7 of 29 WATERSHEDS

rated as high intensity use of surface water - all are in Southern Saskatchewan *(page 62)*

9.7% DECREASE IN GHG EMISSIONS

produced per unit of provincial real GDP since 1997 *(page 22)*

2 established Air Zone Associations in Saskatchewan

The Southeast Saskatchewan Airshed Association (2005) and the Western Yellowhead Air Management Zone (2012) *(page 14)*

Response

The province has faced extreme environmental challenges in its past. The dust bowl of the 1930s ultimately led to changes in agricultural practices that continue to provide benefits today. The same innovation and adaptation that bridged the gap between the environment and the economy then can be applied now to ensure sufficient natural resources for both human and ecological needs into the future

70.1% ZERO-TILL

of land prepared for seeding in 2011, up from 60.2% in 2006 *(page 33)*

5.96 MILLION HECTARES

in Representative Area Network (RAN) approximately nine per cent of the province *(page 36)*

96% successfully regenerated

harvested forest areas in Saskatchewan *(page 53)*

In 2012

87% OF ALL BEVERAGE CONTAINERS RECYCLED

Saskatchewan has the highest return rate of all deposit-paid beverage container programs in Canada *(page 37)*

12,229 TONNES of electronic waste collected between 2007 and 2011

Consecutive yearly increases for first five years of operation *(page 37)*

17% DECREASE IN WATER CONSUMPTION

on average, for 22 watersheds comparing 2007 and 2011 *(page 65)*

Many indicators have pointed toward opportunities to improve the state of the environment. As the Ministry of Environment moves forward in using a results-based regulatory approach, the information in this report will be used to help set future priorities in measuring the health of key components of the environment.

State of the Environment Reporting in Saskatchewan

Introduction

This is the twelfth biennial State of the Environment report for Saskatchewan since 1991. Successive reports have focused and reported on the status and trend of various key components of the environment from both a regional and provincial perspective (Table A). For example, the four reports from 1995 through 2001 featured and described environmental conditions, trends and emerging issues for the Boreal Plain (1995), Prairie (1997), Boreal Shield (1999) and Taiga Shield (2001) ecozones followed by a provincial overview in 2003.

The unique aspect of Saskatchewan's *2013 State of the Environment Report (2013 SoE)* is that it is based on a framework established in the *2011 State of the Environment Report (2011 SoE)* that introduced measurement systems allowing the condition of our environment to be tracked over time. State of the environment reporting also provides us with the ability to trace the performance of legislation and policies, including programs and activities, which are put in place to improve human wellbeing and environmental outcomes.

Saskatchewan's *2013 SoE* assesses the current status of 17 environmental indicators and their trends since the *2011 SoE*, across five theme chapters:

AIR | CLIMATE | LAND | FOREST | WATER

Table A - State of the Environment Reporting in Saskatchewan, 1991-2011

Year	State of the Environment Report	Focus
1991	State of the Environment Report	Broad picture of the condition of the environment and areas of concern
1993	The Need for Environmental Indicators	'Concept' document
1995	The Boreal Plain Ecozone: A Forest Community	Describes current environmental trends, conditions and emerging issues from a regional 'Ecozone' perspective
1997	The Prairie Ecozone: Our Agricutlural Heartland	
1999	The Boreal Shield Ecozone: A Land of Lakes and Forests	
2001	The Taiga Shield Ecozone: Land of the Caribou	
2003	A Provincial Perspective	Provincial overview of previous four reports
2005	State of the Environment Report	Assesses the state of selected environmental components
2007	State of the Watershed Report	Assesses watershed health
2009	State of Saskatchewan's Provincial Forests	Assesses how well forest values are being sustained
2011	State of the Environment Report	Framework of five environmental themes and 17 key indicators to assess and report on the environment.

Note: Reports listed fulfill the Government of Saskatchewan's legislated commitment to report on the state of the environment every two years.

Background and Purpose

Saskatchewan's environment is essential for our wellbeing as well as providing a foundation for the province's growing economy. We have become increasingly aware of the need for quality air, land, water, food and other resources, the importance of sustainable resource use and the environmental diligence required in controlling pollutants to air, land and water.

The *2013 SoE* aims to provide timely, accessible and credible information about the condition of Saskatchewan's environment and pressures acting upon it. The purpose of this information is to raise awareness and understanding of the environment, identify emerging issues and trends, and to highlight the actions needed by the public, First Nations and Métis, industry, business, government and non-government organizations to improve the way we use, manage and balance the environment with a growing and dynamic resource economy.

Saskatchewan legislation mandates the preparation and tabling of a provincial State of the Environment report every two years as required by *The State of the Environment Report Act, 1990* and, when proclaimed, *The Environmental Management and Protection Act, 2010*. In addition to state of the environment reporting, both the Saskatchewan Ministry of Environment and the Water Security Agency also produce annual plans and reports in which various performance indicators are highlighted and tracked (Saskatchewan Ministry of Environment 2012, Water Security Agency 2012).

Reporting Framework

State of the environment reporting is an internationally accepted approach to assess and improve our understanding of the environment, to monitor its health, and to inform our decisions and actions for better management. *The Saskatchewan 2013 State of the Environment Report* uses a framework of environmental themes and selected key indicators, established in the *2011 SoE*, to assess and report on the environment. The *2013 SoE* is organized around five major themes: Air, Climate, Land, Forest, and Water (Figure A). Reported within these five themes are 17 environmental indicators that provide a broad overview of the status and trends of Saskatchewan's natural environment.

The 'Condition-Stressor-Response' model forms the basis for reporting and is an internationally accepted approach for assessing environmental performance.

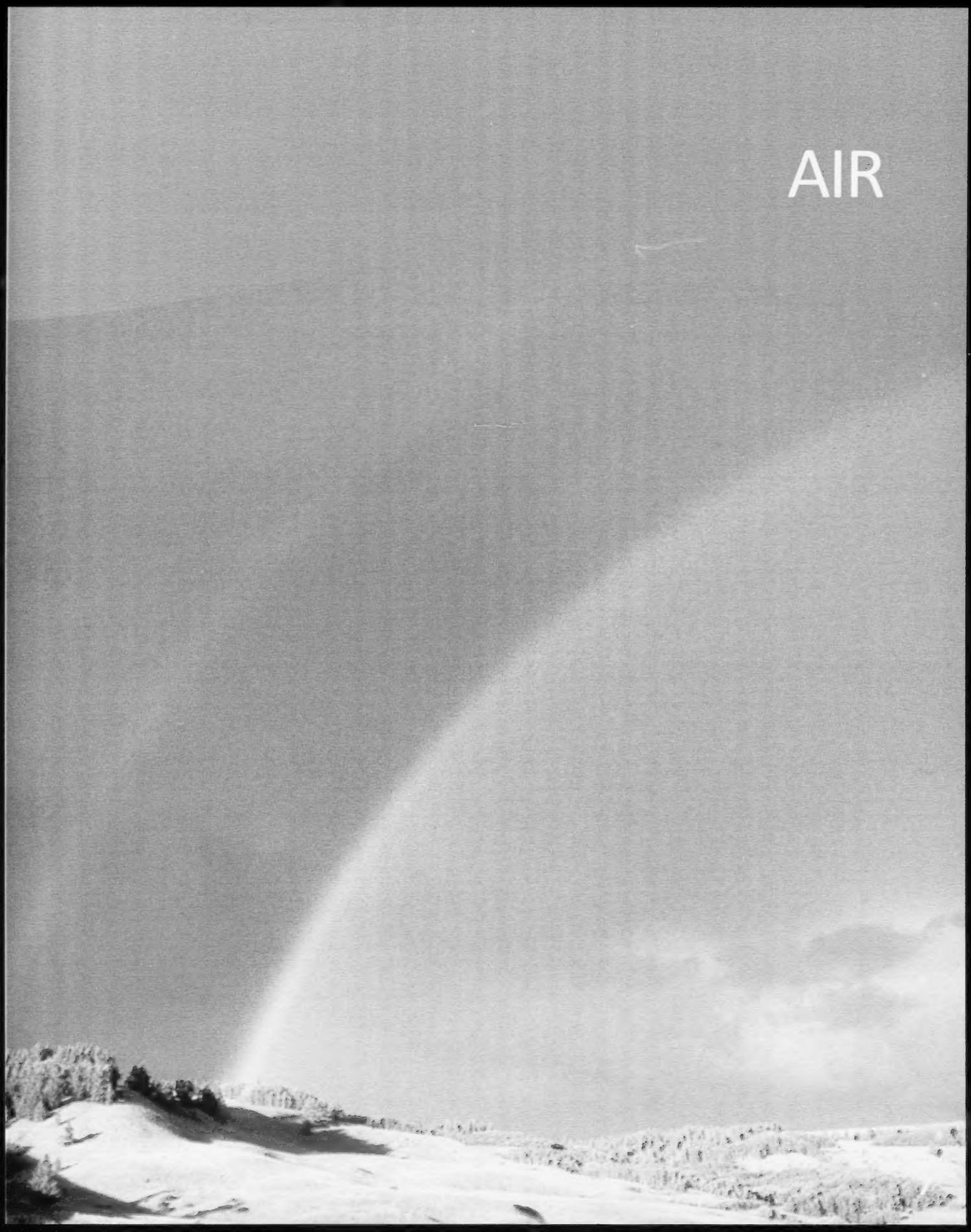
- 'Condition' (or state) refers to the quality of the environment and the functioning of important environmental processes. Condition indicators are used to illustrate the environmental state at any point in time or as a trend
- 'Stressor' (or pressure) refers to human activities that affect the environment. Stressor indicators measure these human activities that impact the condition of the environment
- 'Response' (or actions) refers to initiatives to address pressures on the environment or to improve or maintain its condition. Response indicators represent the management programs and planning activities implemented to improve the condition or state of the environment and to mitigate the stresses. Response indicators measure the success (or outcomes) of management actions or strategies.

Table B - 2013 State of the Environment Framework - Themes and Indicators

AIR	CLIMATE	LAND	FOREST	WATER
Air Pollutant Concentration	Greenhouse Gas Emissions	Agricultural Land Cover	Forest Type and Age Class	Surface Water Quality
		Mineral Disposition Activity	Forest Wildfire Disturbance	
Air Pollutant Volume		Area Under Zero-tillage	Forest Insect and Disease Disturbance	Surface Water Quantity
		Private Land Stewardship	Proportion of Sustainable Harvest Level Utilized	
Air Zone Management		Waste Recycling	Forest Regeneration	Water Consumption and Conservation

The basis for the *2013 SOE* and selection of the reporting themes and indicators, were determined by the following criteria:

- The themes of air, climate, land, forest and water represent parts of the environment or a natural grouping of resources and are the main components that come to mind when we think of the environment. The use of the five themes assisted with structuring the report, including streamlining and grouping indicators to more directly relate to the themes
- The environmental indicators were chosen from a review of a wider set of indicators from past Saskatchewan reports, including the *2009 State of Saskatchewan's Provincial Forests*, the 2007 and 2010 State of the Watershed reports, and the 2003 and 2005 State of the Environment reports
- The 17 indicators found in this report were also selected for their ability to provide:
  - the best representation of information that is currently available
  - data that is relevant, analytically sound, credible and measurable, and
  - comparable data between reporting periods and of sufficient quality to describe changes or trends.


AIR

Key Points

- The Ministry of Environment continuously monitors air quality in the province
- Air quality in Saskatchewan's urban centres is primarily excellent
- Levels of air pollutants are low in the province
- Local stakeholders are actively engaged through two established air zone associations in the Province which are the Southeast Saskatchewan Airshed Association and the Western Yellowhead Air Management Zone

Clean air is vital to the health and well-being of Saskatchewan's people and natural environment. 'Air' is the everyday term for the atmosphere - the intermixed layer of nitrogen, oxygen and other trace gases that surrounds our planet and makes life on Earth possible. Air pollutants in Saskatchewan originate from local, regional and global sources where major influences on air quality include industrial emissions, vehicle emissions, forest fires and agricultural operations. Air quality depends on the rate at which pollutants are emitted into the atmosphere and the ability of the atmosphere to disperse these pollutants. As a result, air pollution can be pervasive and does not recognize property or political boundaries.

Poor air quality can affect human health, the environment and the economy. The very young, elderly or those with compromised immune systems are often the most susceptible to air pollution. Asthma, lung cancer, cardiovascular disease, allergies and other human health problems have been linked to, or can be worsened by, poor air quality. Impacts on plant and animal biological diversity and productivity have also been attributed to pollutants in the atmosphere. Air pollution can have an impact on our economic wellbeing. The desire to prevent air pollution can affect decisions about what we buy, what we use, and how or where it is produced. Repairing the damage caused by air pollution, including health and environmental problems, can have economic implications. On the other hand, the creation of new technologies, knowledge, and jobs to address air quality concerns can produce economic opportunities.

Indicators for Air

Condition

1.1 Air Pollutant Concentration (reported as an Air Quality Index) – Describes the general air quality in Saskatchewan and informs the public about the condition of air in their area in real-time using an index that contains the measured quantities of various pollutants.

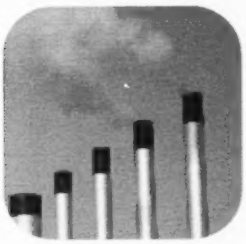
Stressor

1.1 Air Pollutant Volume – Tracks the total amounts of major air pollutants released annually in Saskatchewan.

Response

1.1 Air Zone Management – Outlines an important continuing place-based approach to maintain clean air and ensure effective and efficient air monitoring to complement existing regulatory tools to minimize adverse effects on air quality. Place-based approaches can be defined as stakeholders (in this case the public, industry, communities, non-government and government) involved in a collaborative process to address issues as they are experienced within a geographic space, be it a neighbourhood, a region, or an ecosystem (Policy Horizons Canada 2011).

1.1 Condition Indicator: Air Pollutant Concentration (Reported as an Air Quality Index)



Why is this indicator important?

Measuring and evaluating air quality is an important activity in maintaining Saskatchewan's air quality. The Air Quality Index (AQI) describes the general air quality in Saskatchewan by transforming ambient concentration measurements of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO) and fine particulates ($PM_{2.5}$) into a single number, or index, that represents the measured quality of the air. The index is also used to monitor long-term trends in air quality. Table 1.1 provides a description of the categories of AQI results.

Table 1.1 Air Quality Index (AQI) Rating System

AQI Rating	AQI values	Effects
Excellent	0 – 15	No known harmful effects to soil, water, vegetation, animals, materials, visibility or human health.
Good	16 – 25	No known harmful effects to soil, water, vegetation, animals, materials, visibility or human health. Persons with severe respiratory ailments sensitive to air pollution may notice some minor effects.
Fair	26 – 50	Adequate protection against harmful effects to soil, water, vegetation, animals, materials, visibility and human health. Persons with severe respiratory ailments sensitive to air pollution may need to modify their usual outdoor activities if experiencing effects.
Poor	51 – 100	Not all aspects of the environment and human health are adequately protected from possible adverse effects. The general population should consider reducing or rescheduling strenuous outdoor activities and higher risk populations should reduce or reschedule outdoor activities.
Very Poor	value >100	Continued air quality in this range could pose high risk to environment and public health.

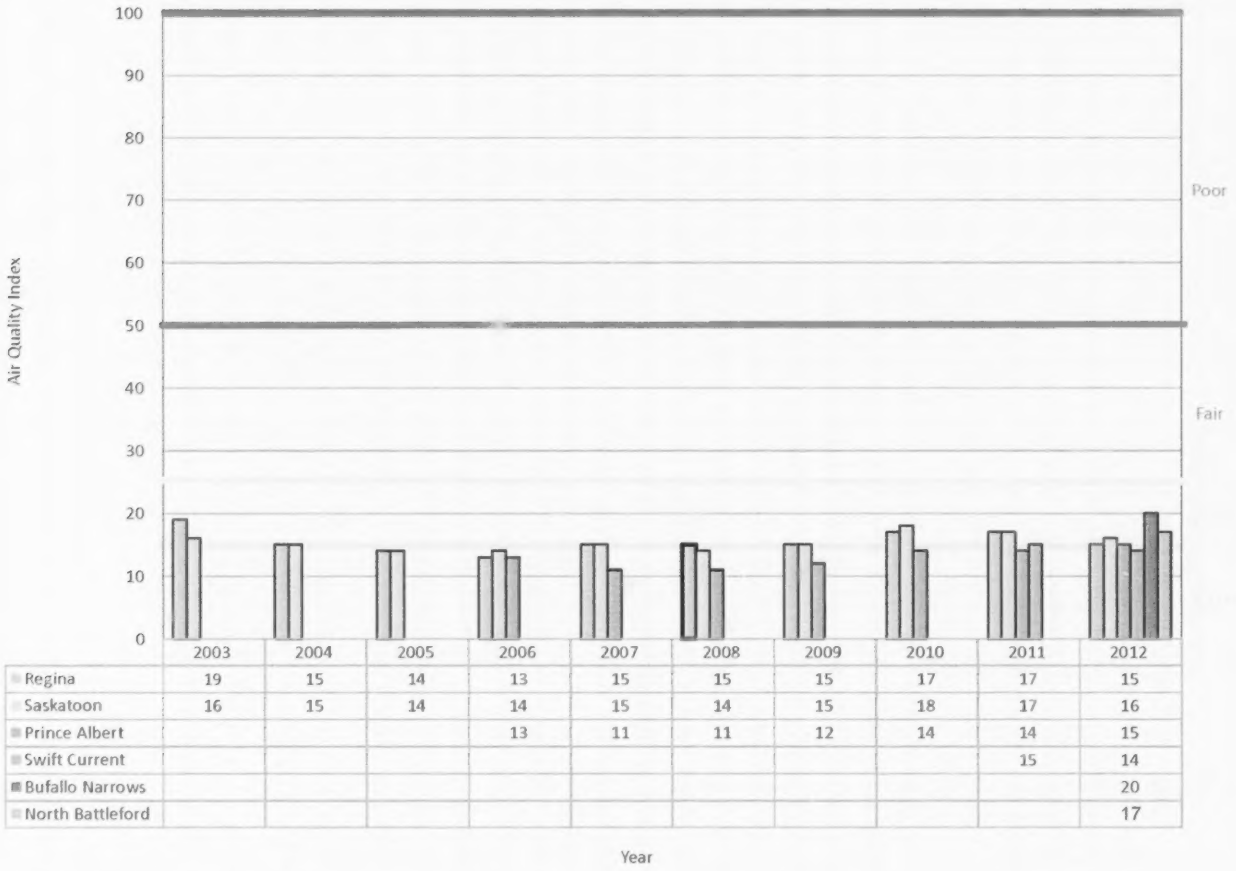
Source: Saskatchewan Ministry of Environment 2011

What does this indicator show?

Yearly averages of Air Quality Index ratings have been determined for Regina and Saskatoon from 2003 to 2012, for Prince Albert from 2006 to 2012, Swift Current from 2011 to 2012 and for Buffalo Narrows and North Battleford for 2012 (Figure 1.1.)

The indicator shows that air quality in Saskatchewan is primarily excellent with no anticipated harmful effects. The AQIs for Regina, Saskatoon, Prince Albert and Swift Current have consistently rated good to excellent and there has been a relatively stable trend in this measure. The slightly elevated levels in 2010 and 2011 for Regina and Saskatoon are due to higher particulate matter levels caused by forest fire activity in the province and in other parts of the country. Forest fire smoke results in short-term poor air quality and consequently the AQI is slightly higher than what is typically recorded. The AQI in northern communities, such as Buffalo Narrows, would be expected to be higher than in the south mainly due to higher background ozone levels, higher particulate matter levels due to forest fires and human-caused emissions from open and wood stove burning sources.

Figure 1.1 Annual Air Quality Index ratings for Regina, Saskatoon, Prince Albert, Swift Current, Buffalo Narrows and North Battleford, 2003-2012



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Regina	19	15	14	13	15	15	15	17	17	15
Saskatoon	16	15	14	14	15	14	15	18	17	16
Prince Albert				13	11	11	12	14	14	15
Swift Current									15	14
Bufallo Narrows										20
North Battleford										17

Source: Ministry of Environment, Technical Resource Branch 2013

What actions are being taken?

The Ministry of Environment ensures new industrial developments use the most appropriate technology to reduce air emissions. The Ministry conducts continuous air quality monitoring at five sites in the province - Regina, Saskatoon, Prince Albert, Swift Current, North Battleford and Buffalo Narrows (the last two were recently added).

The public can access air quality information for the six monitored sites, in real-time, on the Saskatchewan Ministry of Environment's website (http://www.environment.gov.sk.ca/airqualityindex). It is anticipated that additional sites will come on-line as future permanent monitoring sites are initiated in both urban centres and regional air zones of the province. Saskatchewan also receives and analyzes data from the federal government on the amount of pollutants released by major industry sectors through the National Pollutant Release Inventory program (Environment Canada 2012).

To spot check and measure ambient air quality in locations outside the six sites with continuous monitoring, the Ministry of Environment operates a vehicle equipped to monitor a variety of air pollutants known as the Saskatchewan Air Monitoring Laboratory (SAML). In 2011, the SAML was deployed to 13 locations in 8 different communities, which include: Weyburn (3 locations), Regina (2 locations), Yorkton (2 locations), Belle Plaine (2 locations), Saskatoon, Estevan, Paradise Hill and Bethune. The locations were chosen based on population density, emission sources, background levels, modeling results, and public concerns. Monitoring results for all measured pollutants were well within provincial ambient air quality standards.

In 2012, the SAML was used to conduct an extensive air quality monitoring survey in the City of Regina and surrounding area. The purpose of the survey was to proactively identify and quantify possible pollutants before they become a problem. The study will continue until the end of June 2013 with results published and made available to the public on the Ministry's website (Refer to Local Snapshots at the end of this chapter for more information).

Provinces within Canada are making the transition to the Air Quality Health Index (AQHI), which has a greater focus on human health. The Ministry will be making the transition to an hourly AQHI in 2013 but will continue to use the annual AQI, as it is a better overall long-term performance measure of the state of the environment.

1.2 Stressor Indicator: Air Pollutant Volume

Why is this indicator important?

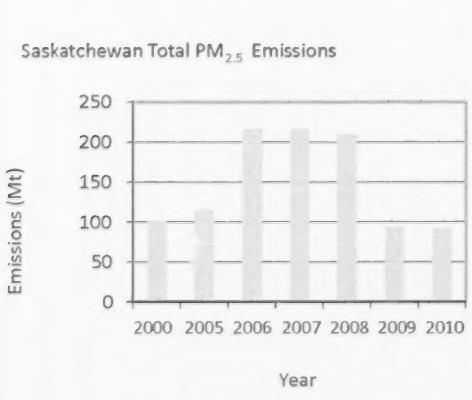
This indicator shows the total amounts, (tonnes per year) of major air pollutants released annually in Saskatchewan. Levels of specific air pollutants are reported either as Criteria Air Contaminants (CACs) or non-CACs (Environment Canada 2013). CACs are a group of air pollutants that affect human health and contribute to air pollution problems such as smog, acid rain, and poor air quality. They include particulate matter (of varying sizes), sulphur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), ground level ozone (O_3), and volatile organic compounds (VOCs). In most cases, they are the products of burning fossil fuels or industrial processes.

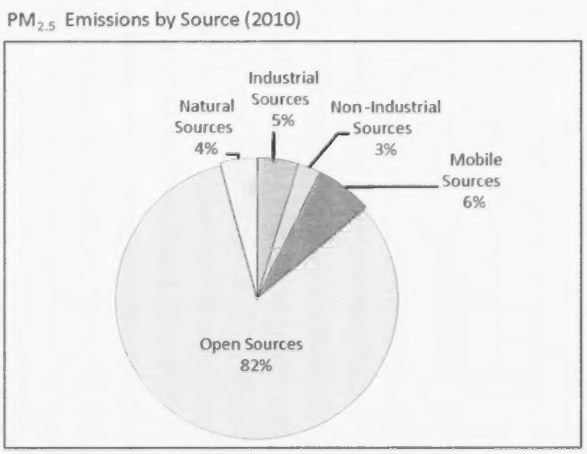
What does this indicator show?

Annual levels of three major CACs, as reported by the National Pollutant Release Inventory (Environment Canada 2012), accompanied by a breakdown of pollutants by emission source for 2010 are presented in Figures 1.2., 1.3 and 1.4. Emission sources and major contributing sectors include industrial (oil and gas and mining industries), non-industrial (electricity and fuel combustion), mobile (transportation), open (agriculture, waste and road dust) and natural (forest fires). A further definition of emission source terms is found in the report glossary (Page 74). CAC levels have remained relatively constant over the reporting period. Exceptions are particulate matter increases in 2006, 2007 and 2008 (Figure 1.2), mainly due to above normal forest fire activity in Saskatchewan and other parts of the country.

Overall, releases of air pollutants in Saskatchewan are low compared to other provinces. For example, in comparing Alberta with Saskatachewan, Alberta's CAC releases have been over two times higher than Saskatchewan for particulate matter ($PM_{2.5}$); around three times higher for sulfur oxides (SO_x); and five times higher for nitrogen oxides (NO_x) (Environment Canada 2012).

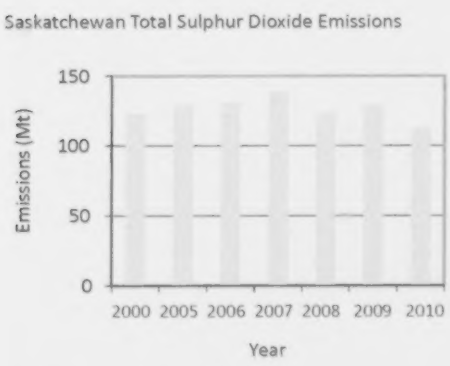
Figure 1.2 Particulate Matter ($PM_{2.5}$ microns) Emissions in Saskatchewan





Source: Environment Canada 2012

Figure 1.3 Sulphur Dioxide Emissions in Saskatchewan



Source: Environment Canada 2012

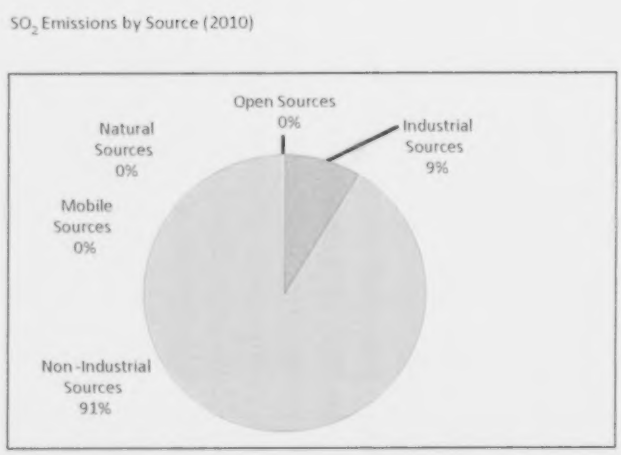
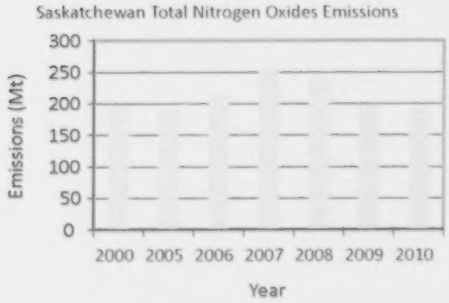
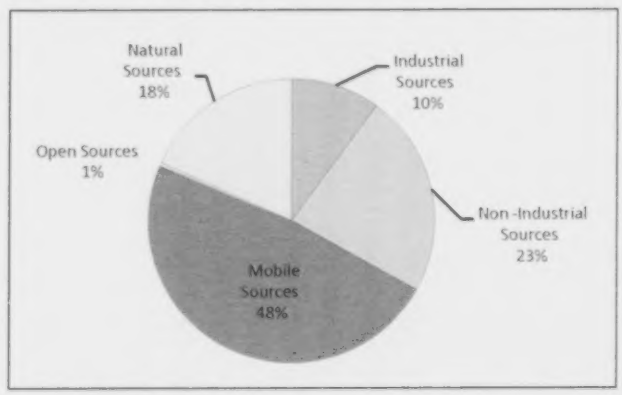


Figure 1.4 Nitrogen Oxide Emissions in Saskatchewan



Source: Environment Canada 2012



What actions are being taken?

The Ministry of Environment continues to collaborate with Environment Canada and supports the National Pollutant Release Inventory program that collects, stores, and distributes annual air emissions data from all sources in Saskatchewan and other provinces and territories. Saskatchewan is a member of the national Emissions Working Group whose mandate is to advise on the compilation and reporting of national inventories, trends, and projections for air pollutants of concern. The province reports particulate matter and ozone levels on a five year basis to the Canadian Council of Ministers of the Environment (CCME 2006).

Saskatchewan has a wide-range of regulatory tools to ensure activities in the province minimize air quality impacts. *The Clean Air Act 1989* (with subsequent amendments), the development of modern legislation (*The Environmental Management and Protection Act, 2010*) and the Environmental Code all demonstrate the government's commitment to a healthy environment along with continuous improvements to maintain clean air in the province.

The legislation applies to any facility, operation, activity or equipment that is a source or potential source of an air contaminant in Saskatchewan. The Ministry of Environment issues clean air permits to operators of industrial sources, incinerators and fuel burning equipment in the province that contain conditions and requirements such as monitoring, modeling, reporting, and compliance. The Ministry continues to work with larger and more complex operations to maintain good air quality through the issuance of clean air permits. The Ministry is also improving regulation for simpler operations through research and implementation of efficient new tools. These tools include policies, codes of practice, industry association requirements, and the development of a results-based regulatory model and the Saskatchewan Environmental Code (Saskatchewan Ministry of Environment 2009).

The Ministry of Environment monitors operational performance through compliance inspections of regulated activities, review of compliance reports, investigation of infractions and enforcement when warranted. Industry continues to operate and make improvements to ensure their air quality meets Saskatchewan's Ambient Air Quality Standards, minimizing the adverse impact on human and ecosystem health.

One issue in Saskatchewan is the possibility of higher than normal acidic precipitation (acid rain). Within 300 kilometres of the Alberta Athabasca Oil Sands Region mining activities, the Ministry of Environment assessed acid sensitivity for 259 headwater lakes in northwest Saskatchewan in the fall from 2007 to 2011. Results show that 68 per cent of the surveyed lakes can be classed as sensitive to very sensitive to acid deposition due to their low buffering capacity (Scott et al. 2010). In 2011, the Ministry initiated work to map soils sensitivity to acid deposition in northern Saskatchewan and to provide a baseline for future developments in northern Saskatchewan. Together with the results from the regional lakes assessment, this new data gives a more integrated picture of landscape sensitivity, allowing better assessment of possible impacts of acid forming emissions.

Environment Canada conducted similar lake surveys across northern Saskatchewan in the Boreal Shield lakes in 2007 and 2009 (Jeffries et al. 2010) and again in 2012 north of Lake Athabasca in the Taiga Shield lakes. The results of both surveys have been used to update national maps of aquatic critical loads of acidity (maximum acid input tolerable as a long-term annual average to minimize biological damage). Comparing these maps to modeled acid deposition for northern Saskatchewan suggests that acidification risks may exist for some lakes and closer monitoring and evaluation is required to ensure an immediate mitigation response if needed. *An Integrated Oil Sands Environmental Monitoring Plan*, released in 2011 by Environment Canada, now sets a path forward for longer-term commitments to regional monitoring, including northern Saskatchewan (Environment Canada 2011).

1.3 Response Indicator: Air Zone Management

Why is this indicator important?

The maintenance and expansion of air zones in the province demonstrates the Ministry of Environment's progress towards improved models of air pollutant management that best protect human health and the environment. An air zone is a regional geographic area that shares similar air quality characteristics and challenges. Its boundaries are typically established by considering topographic features, meteorology, economic activities, pollution sources, political boundaries and common air quality issues.

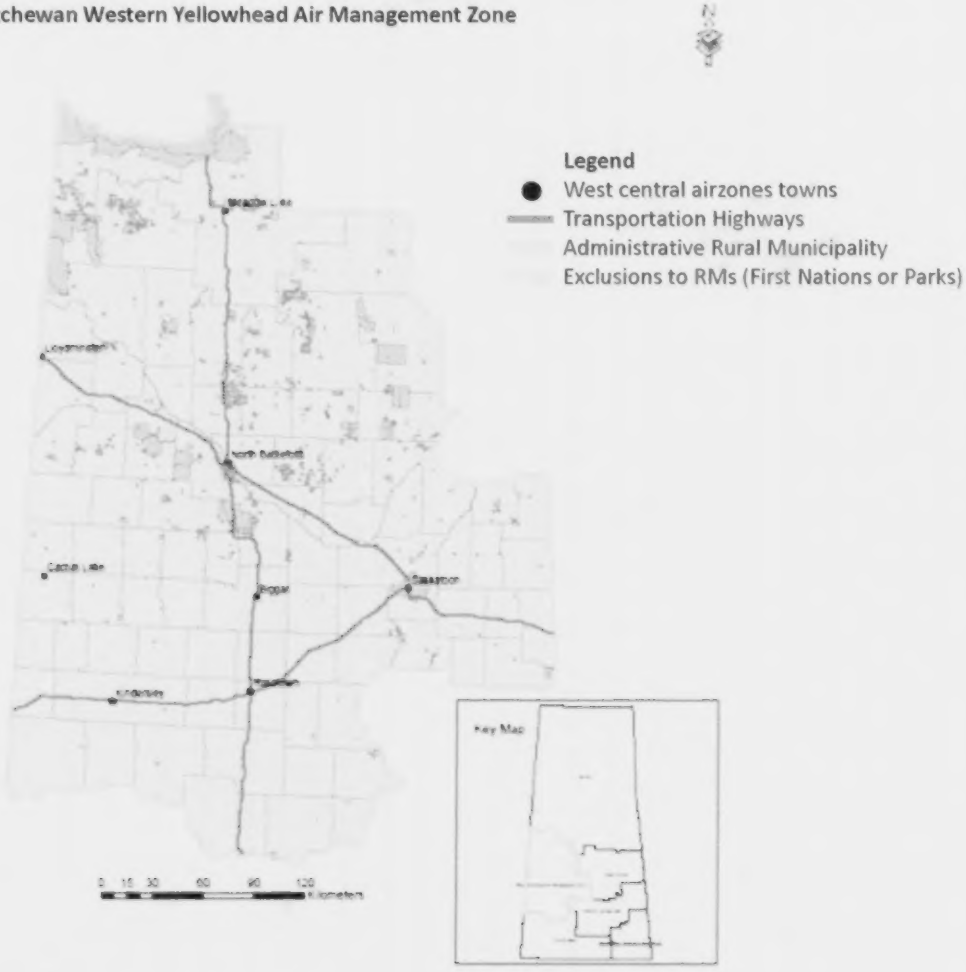
What does this indicator show?

Air zones are a viable management strategy that provides improved communication of air quality to those living within its boundaries. It allows for a more focused, local approach to air quality management, and shows in a timely fashion if the regional air quality meets provincial standards as well as identifying 'hot spots'.

Currently, Saskatchewan has two active air zones, the Southeast Saskatchewan Airshed Association (SESAA), operating since 2005 (Saskatchewan Ministry of Environment 2011) and the recently established Western Yellowhead Air Management Zone (WYAMZ) operating since 2012 (Figure 1.5). Both air zones have public, industry, government and non-government members managed by an Executive Director and Board of Directors with committees for finance, science, communications and governance. Real-time air quality data and the association's annual reports, which report on passive and continuous air monitoring data, are available on their websites (http://www.sesaa.ca and http://www.wyamz.ca).

Saskatchewan plans to develop four additional new air zone associations over the next couple of years. The Regina - Moose Jaw - Yorkton Air Management Zone is the next proposed air zone in Saskatchewan with additional air zones to be established in the boreal, east central, and south west regions of the province in the near future.

Figure 1.5 Map of Saskatchewan Western Yellowhead Air Management Zone



Source: Saskatchewan Ministry of Environment, Geomatics Services 2012

What actions are being taken?

The Ministry of Environment intends to have air zones set up across the entire province. They will be based on an air zone association model established in 2005, and will integrate with the new Canada-wide Air Quality Management System (AQMS). The AQMS has been developed by federal, provincial, and territorial jurisdictions. On October 11, 2012 the Canadian Council of Ministers of the Environment (CCME) agreed to begin implementation of the Canada-wide AQMS in 2013. The new comprehensive air management system is outcome-based, defining the desired ambient air quality through setting Canadian Ambient Air Quality Standards. It is also a place-based system with air zones for management, established within provinces and territories to ensure local needs and circumstances are effectively addressed.

Saskatchewan continues to contribute to various aspects of AQMS including:

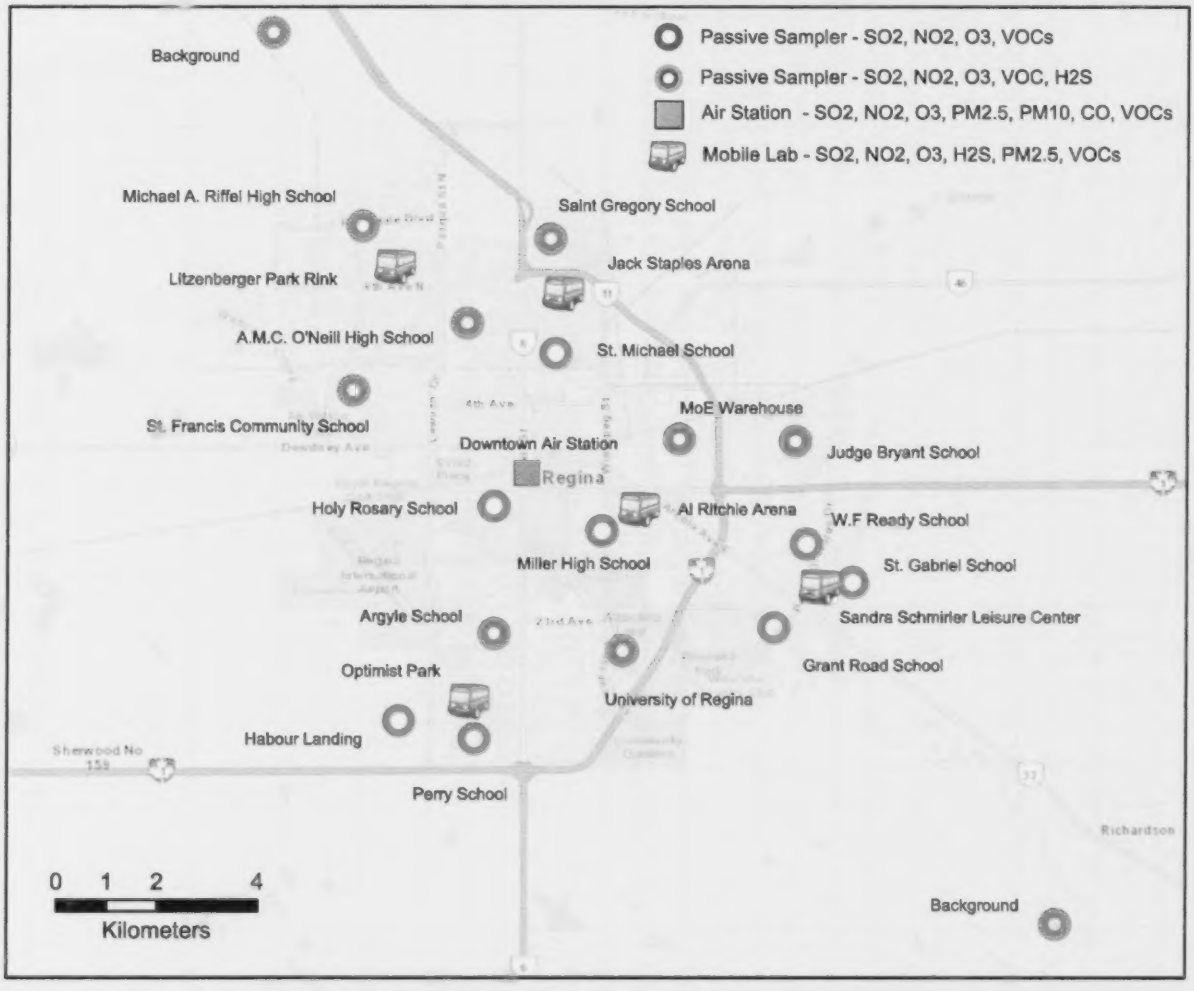
- establishment of base level emission guidelines for industrial sectors such as electricity, potash, chemicals, steel production, pulp and paper, upstream oil and gas, oil sands and petroleum refining;
- review of the Canadian Ambient Air Quality Standards that provide an enhanced level of protection for human health and the environment; and
- the creation of agreements on regulatory assurance and mechanisms for stakeholder engagement. Environmental non-government organizations have been invited to join working groups to help develop performance standards with industry and government representatives.

Air zone management fits with the Ministry's new results-based regulatory model and the Saskatchewan Environmental Code. Air zone associations in Saskatchewan will become valuable organizations that will monitor industrial point sources and other sources. Air zone management can provide flexibility to consider regional differences while ensuring national consistency, managing issues associated with trans-boundary influences and providing a level playing field for industry.

Regina Air Quality Monitoring Study

The monitoring of Regina's air shows that it is of high quality. To continue the vigilance of checking the status and trend of the city's air, a comprehensive air quality monitoring study was initiated in 2012; the first of its kind in Saskatchewan. The Ministry of Environment, along with the Ministry of Health, the Regina Qu'Appelle Health Region and the City of Regina are trying to gain a better understanding of Regina's air quality in the city's residential neighborhoods by conducting an extensive air monitoring survey. This survey will: provide baseline data to compare with possible future monitoring studies; proactively identify potential pollutant concerns before they become a problem; and assist with determining where additional permanent monitoring stations should be located. Different monitoring methods (see map) were used to collect monthly measurements at 18 sites for nitrogen dioxide (NO_2), ozone (O_3), sulphur dioxide (SO_2), hydrogen sulphide (H_2S) and over 25 different volatile organic compounds (VOCs). The Saskatchewan Air Monitoring Laboratory (SAML) was also deployed to collect real-time data at five different sites in the city on a scheduled rotation for particulate matter ($PM_{2.5}$), NO_2, O_3, SO_2, H_2S, and over 150 VOCs. The monitoring program is currently ongoing. Once an entire year of data has been collected, the results will be made available to the public on the Ministry of Environment's website.

Figure 1.6 Air Quality Monitoring Methods and Collection Sites, City of Regina



Source: Saskatchewan Ministry of Environment, Technical Resources Branch 2012

Saskatchewan's Second Air Management Zone

The Western Yellowhead Air Management Zone (WYAMZ) was incorporated in February, 2012 to collect air quality data in the west central region of the province. The WYAMZ area is the second air management zone in Saskatchewan, the first being the Southeast Saskatchewan Airshed Association (SESAA) that was established in 2005. An air zone association operates as an independent, collaborative non-profit organization of industry, government and other representatives to collect credible, continuous air quality data, and to communicate data and information to member organizations, the government, and the public. Proposed initial data collection sites in the WYAMZ include continuous air quality monitors located in the communities of Saskatoon, North Battleford, Lloydminster, and Kindersley and a passive monitoring network across the region. Once the sites are operational, WYAMZ will display live air quality readings on their website, http://www.wyamz.ca/

Highlights for Air

Saskatchewan's air is of high quality, meets Saskatchewan's Air Quality Standards and poses little cause for concern. Pollutant levels are low and are continuously monitored and reported by the Ministry. Saskatchewan currently has two established air zone associations that monitor air quality, and four more are in the planning stages. One emerging issue is the possibility of higher than normal acidic precipitation originating in Alberta. The Ministry conducted lake acid sensitivity assessments in northwest Saskatchewan from 2007 to 2011, along with a similar assessment across northern Saskatchewan in collaboration with Environment Canada. These programs are ongoing, with initial data indicating that acidification risks may exist for some lakes due to their low buffering capacity but none are considered acidified.

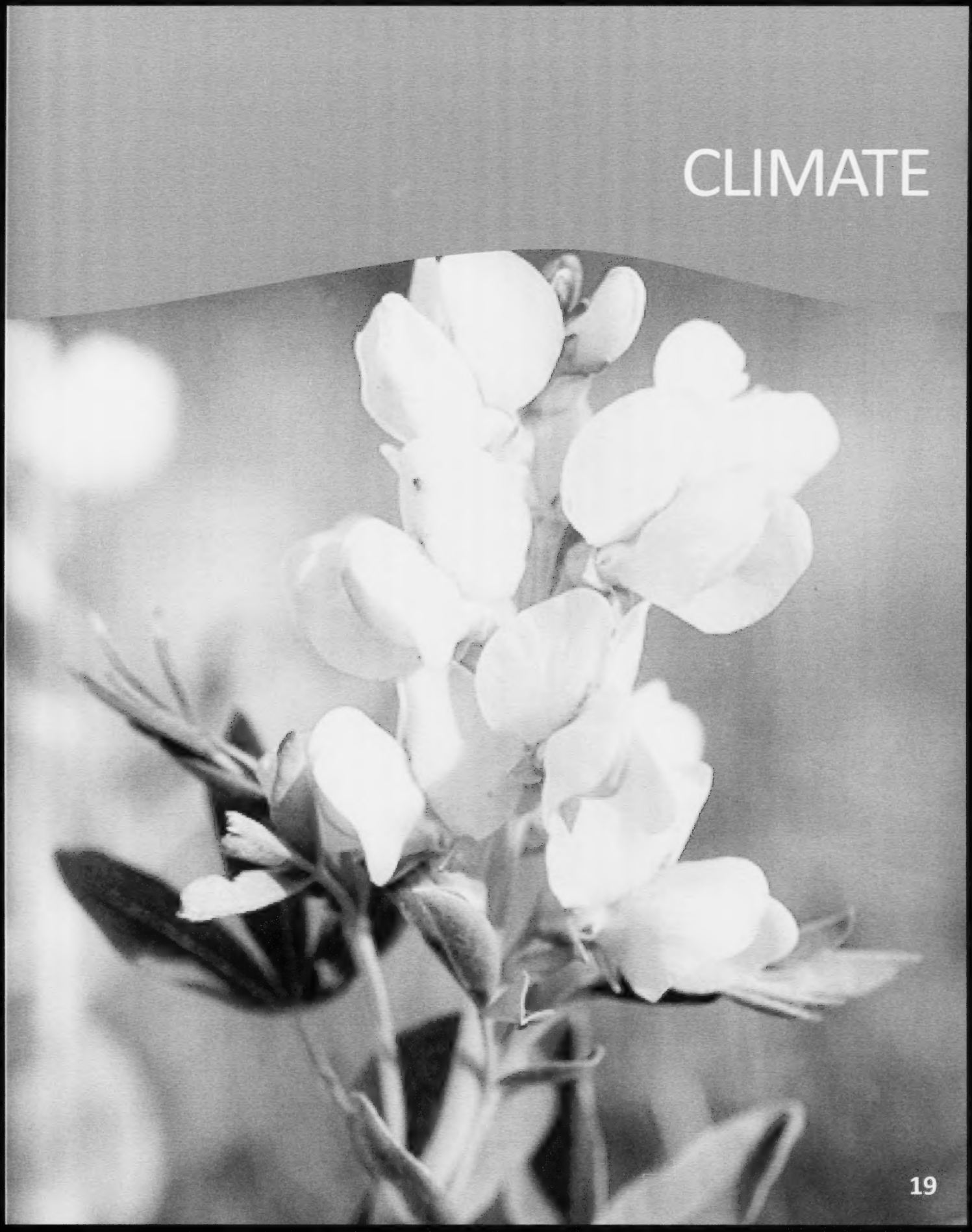
The status and trend of the three 'air' indicators reported on in this chapter are summarized as follows:

1.1 **Air Pollutant Concentration** – The air quality index data shows a positive environmental condition, in that air quality is primarily excellent, with no significant change in the results of the measure.

1.2 **Air Pollutant Volume** – Air pollutants have remained relatively constant over the reporting period with no significant change in the results of the measure.

1.3 **Air Zone Management** – The status of this response indicator is positive as there are now two air zone associations in the province compared to one association that was highlighted in the *2011 SoE*. The trend is increasing with plans to develop four additional air zone associations.

CLIMATE



Key Points

- Saskatchewan's greenhouse gas (GHG) emissions are increasing in conjunction with the growing economy
- GHG emissions produced, per unit of provincial real GDP, have decreased by 9.7 per cent since 1997
- The Province is working with industry and other stakeholders to reduce GHG emissions through new results-based regulations and investments in innovative technology and solutions

Climate Change

Human activities and the release of greenhouse gases (GHGs), such as carbon dioxide (CO_2) and methane (CH_4), are causing the planet's climate to change. Globally, the level of atmospheric carbon dioxide is increasing and 84 per cent of this increase is estimated to be due to emissions from fossil fuel combustion (Environment Canada 2004).

Climate scenario studies have explored how these projected global climate changes may have an impact in Saskatchewan (Barrow 2009). For both the forested and prairie regions of Saskatchewan, overall increases in both precipitation and mean annual temperatures are predicted. Trends have shown a larger increase in daily minimum as compared to maximum temperatures and the largest warming has occurred during winter and early spring, resulting in a longer frost-free period and more growing degree days. With a warmer, longer summer, the deficit between precipitation and potential water loss by evapotranspiration has been growing in southern Saskatchewan (Sauchyn et al. 2009). Thus, in the long term, although precipitation is expected to increase, water deficits are forecasted due to water loss from evapotranspiration exceeding precipitation. In addition, variability in weather patterns, due to climate change, has the potential for a greater frequency of extreme weather events.

Changes in Saskatchewan's climate are expected to have impacts on our natural resources, and the industries dependent on them. Saskatchewan potentially faces major climate change effects on ecosystems and landscapes. Drier growing seasons will be the single most important ecosystem impact and will present a challenge to the conservation of fish, wildlife and biodiversity. Agriculture is an important sector of the Saskatchewan economy and already experiences naturally occurring extreme weather conditions. Climate impacts on the agricultural sector and adaptive responses are already occurring and are likely to accelerate in the future. Forests in Saskatchewan are also subject to a range of climate and other natural disturbance factors.

Indicators for Climate Change

Stressor

1.1 Greenhouse Gas Emissions - Examines the trends in total GHGs in Saskatchewan, as well as emissions by sector. It also shows the comparison of GHG emissions with Saskatchewan's Gross Domestic Product (GDP).

1.1 Stressor Indicator: Greenhouse Gas Emissions

Why is this indicator important?

The level of greenhouse gas emissions is an indicator of human activity affecting the global atmosphere and causing most of the increase in global temperatures. GHGs include mainly carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and water vapour.

Saskatchewan's GHG emissions form a small fraction of the total global output considering Canada produces 1.84 per cent of the world's carbon dioxide (World Resources Institute 2005) and about 1.5 per cent of total global GHG emissions (Environment Canada 2012). The province accounts for 10.4 per cent of Canada's total GHGs (Environment Canada 2012) with three per cent of the country's population. Saskatchewan is the steward of extensive natural (forests, wetlands, grasslands) and agricultural ecosystems that capture and store carbon from the atmosphere.

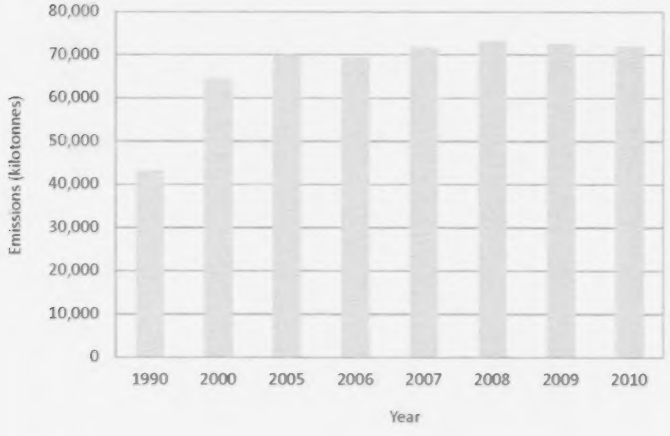
What does this indicator show?

GHG emissions can be interpreted in various ways. Figure 2.1 shows the total annual GHG emissions in Saskatchewan from 1990 to 2010. Figure 2.2 provides the provincial sources of these GHGs in 2010 and Figure 2.3 illustrates the annual emissions per unit of Saskatchewan's Gross Domestic Product (GDP) from 1990 to 2010 (Environment Canada 2012, Saskatchewan Bureau of Statistics 2012).

GHG emissions in Saskatchewan have increased by 66.9 per cent from 1990 to 2010 (Figure 2.1) and, as of 2010, stand at 72,100 kilotonnes per year. In recent years, GHG emissions have stabilized even with strong provincial economic and population growth. As shown in Figure 2.2, most of the emissions are generated by oil and gas & mining industries (34 per cent), electricity and heat generation (21 per cent), transportation (21 per cent) and agriculture (16 per cent).

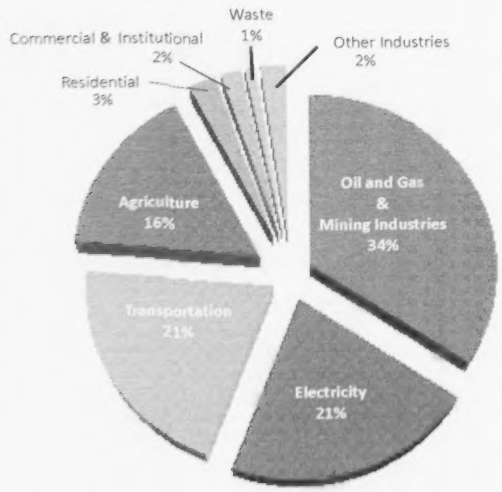
Despite the overall increase in GHG emissions, the amount of emissions released per unit of provincial real GDP has decreased by 9.7 per cent since 1997 (Figure 2.3), indicating that the Saskatchewan economy is becoming more efficient at creating wealth and that some sectors of the economy are becoming less resource intensive.

Figure 2.1 Annual Greenhouse Gas Emissions in Saskatchewan, 1990-2010



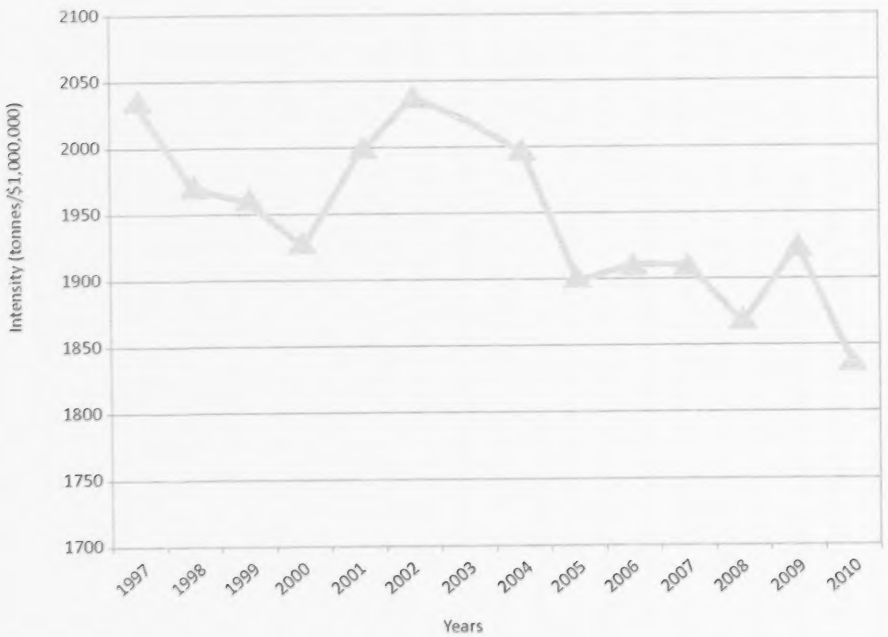
Source: Environment Canada 2012

Figure 2.2 Sources of Greenhouse Gas Emissions in Saskatchewan, 2010



Source: Environment Canada 2012

Figure 2.3 Annual GHG Emissions Intensity Trends of Real GDP in Saskatchewan, 1997-2010



Source: Environment Canada 2012

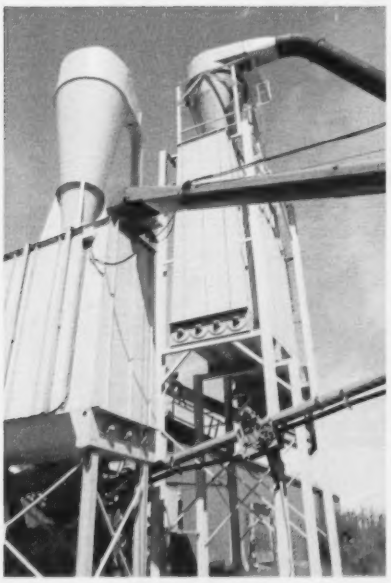
What actions are being taken?

The provincial Climate Change Plan will promote emission reductions in all sectors of the economy through the regulation of large emitters, and policy measures and incentives in non-regulated sectors. An amendment to *The Management and Reduction of Greenhouse Gases Act* is currently under legislative review. This amendment is necessary for the negotiation of an equivalency agreement with Environment Canada that achieves equal or better environmental outcomes than the federal coal-fired electricity regulatory framework, under provincial regulation. The outcomes-based equivalency agreement will avoid overlap of regulations or duplication of efforts, and will provide flexibility for regulated emitters to meet their required baseline emission levels through the use of compliance mechanisms such as the Technology Fund, offsets, pre-certified investments, performance credits and recognition for early action.

The Ministry is taking innovative actions to advance our ability to measure, report and monitor GHG emissions. The Saskatchewan Environmental Code Chapter, related to climate change, deals with baseline emission levels and annual reporting. The Chapter applies to regulated emitters and establishes measurement, reporting and verification requirements for calculating baseline emission level and annual inventories of GHG emissions.

Performance agreements will be developed to reduce emissions in non-regulated sectors, including upstream oil and gas, municipal governments, and the business community. This will include the development of an offset protocol for conservation of associated gas from reduced flaring and venting emissions.

The Go Green Fund will continue to support research and demonstration of cost-effective programs such as energy efficiency for new homes, and technological innovation to reduce GHG emissions by municipalities and small and medium sized commercial enterprises.



Meadow Lake Wood Pellet Project: Bioenergy for northern applications
Wood biomass can be used as fuel and is a source of energy that can lessen dependency on fossil fuels such as natural gas, propane or heating oil. In a joint initiative involving Meadow Lake Tribal Council Resource Development Limited Partnership and the Saskatchewan Research Council, with support from Saskatchewan's Go Green Fund, a demonstration pellet production facility and four independent heating test sites were built to determine the economic and environmental benefits of pellet production and heating in Northern Saskatchewan. As part of this pilot project, sawmill waste material (sawdust, wood shavings, bark) is redirected from incineration in a 'beehive burner' and instead transferred to a local facility where it is compacted into high energy wood pellets to fire a boiler providing heat to buildings. Biomass energy is considered greenhouse gas neutral as the carbon in biomass is already part of the active carbon cycle, unlike fossil fuels which release carbon that has been sequestered for millions of years. The test sites confirmed that wood pellets have several positive impacts on the environment, economy, and reduce reliance on fossil fuels. Furthermore, the Meadow Lake Bioenergy Centre was announced in August 2012 and includes the development of a biomass power generation project to produce up to 36 megawatts of renewable low-emission power, enough to power approximately 30,000 homes.

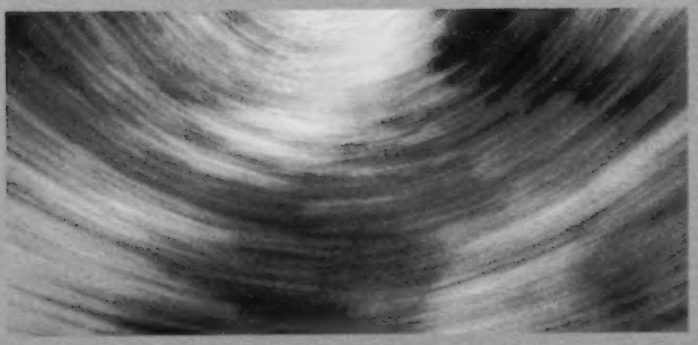
Climate Change and the Island Forests in Central Saskatchewan
The southernmost provincial forests in central Saskatchewan are characterized by patches of isolated boreal forest cover dominated by either jack pine or trembling aspen, 60 per cent of which are more than 70 years old. These Island Forests could be considered the "canary in the mine shaft"; where the impacts of climate change are likely to occur earlier here than in the contiguous boreal forest to the north. The Island Forests may already be showing signs of climate change impacts, and are likely to be severely affected in the future by increased winter temperatures, increased aridity and increased disease, insect and fire hazards. Experimental planting and monitoring of non-native species may help identify species that will grow better under these future conditions. In 2007 and 2008, the Saskatchewan Research Council (SRC) established a long-term non-native conifer tree species trial within the Island Forests that surround Prince Albert. The purpose was to compare plantation success in light of forest health, productivity and climate change concerns. Six non-native species from various regions of North America and the circumpolar boreal forest were planted including red pine, ponderosa pine, lodgepole pine, scots pine, colorado blue spruce and siberian larch. Two species native to the region, jack pine and white spruce, were planted for comparison. All species were previously introduced to these forests, had shown good potential, and were identified for use in this study. Each of the trial plantings are about 40 hectares in size replicated in the Canwood, Nisbet and Fort-a-la-Corne forests, with a total of 190,000 seedlings planted. After six growing seasons, jack pine and scots pine show the best results so far.

AQUISTORE: Saskatchewan's Deep Saline CO_2 Storage Research Project

Aquistore is an independent research and monitoring project managed by the Petroleum Technology Research Centre (PTRC) and supported by industry and government. The project's purpose is to demonstrate that capturing and storing carbon dioxide (CO_2) deep underground in a saline sandstone formation, is a safe, workable solution to reduce greenhouse gases. Results of the project will be available for the benefit of future carbon capture storage projects throughout the world, government policy and regulation development, and for large stationary industries to consider geological storage as an option for mitigating greenhouse gas emissions. Up to 2,000 tonnes of Co_2 equivalent could be stored per day if technology proves successful.

Energy Efficient Refrigeration and Freezer Units Using Seasonally Cool Air

Grocery and convenience stores use large amounts of electricity to operate refrigerators and freezers. In Saskatchewan, exterior temperatures during the winter months, and portions of spring and fall, are cold enough to maintain these units at the correct temperatures. Using outside cold air for cooling may significantly reduce the amount of electricity needed for efficient cold storage. A Regina grocery store, Eat Healthy Foods, has partnered with the Go Green Fund to conduct a study that will determine the cost effectiveness of using outside cold air to operate refrigerators and freezers. This project will test different types of coolers using technologies based on outside air for inside refrigeration and freezers. If successful, the technology may be expanded into other facilities using refrigerators and freezers for food and beverage storage.



Highlights for Climate

Although Saskatchewan emits a small percentage of the world's GHG emissions, the province's emissions continue to increase largely because of its resource-based economy. The Government of Saskatchewan is addressing this through modern legislation, results-based regulation and investments in innovative technology and solutions. At the same time, we must plan for climate change and its impacts. It is important for individuals, organizations and government to work together to mitigate and adapt to the long-term impacts of climate change.

The status and trend of the climate change indicator reported on in this chapter is summarized as follows:

1.1 **Greenhouse Gas Emissions** - Saskatchewan's greenhouse gas (GHG) emissions have increased along with the growing economy. In recent years, GHG emissions have stabilized even with strong provincial economic and population growth.

LAND

Key Points

- Improvements in agricultural practices, such as reduced summerfallow and increasing zero-tillage, are improving the environmental health of agricultural lands
- Potential pressure on land from industrial developments is increasing
- Industry and government are continuously improving their environmental management practices
- Waste recycling efforts are increasing, reducing the pressure on land
- Private conservation stewards, together with Government of Saskatchewan conservation programs, play a critical role in monitoring and maintaining a healthy environment

Saskatchewan has an abundance of land, space and natural resources. From cattle ranching and farming on the southern prairies to hard rock mining on the northern shield, land use in Saskatchewan is varied. From this abundance, economic opportunities develop that benefit all the citizens of the province and it's anticipated that these opportunities will continue into the future. The Ministry of Environment has been proactive in ensuring a balanced approach to addressing economic pressures of growth with environmental protection. Issues such as native prairie conversion, the intensity of agriculture on the landscape, and industrial exploration and development are at the forefront of the Ministry's continued vigilance in its monitoring and measurement of the changes to our land.

Indicators for Land

Condition

3.1 Agricultural Land Cover - Tracks trends in land cover and management practices over time and serves as a proxy for agri-environmental health.

Stressor

3.2 Mineral Disposition Activity - Provides an indication of interest in Saskatchewan's mineral resources and possible future expansion of industrial activity.

Response

3.3 Area Under Zero-Till – Tracks changes in the area of farmland in Saskatchewan under zero-till and other forms of tillage.

3.4 Private Land Stewardship – Tracks conservation trends in the agricultural landscape. In addition to conservation actions by landowners, complementary government actions are reported on for maintaining healthy ecosystems.

3.5 Waste Recycling - Tracks trends in the proportion of materials recycled in Saskatchewan.

3.1 Condition Indicator: Agricultural Land Cover

Why is this indicator important?

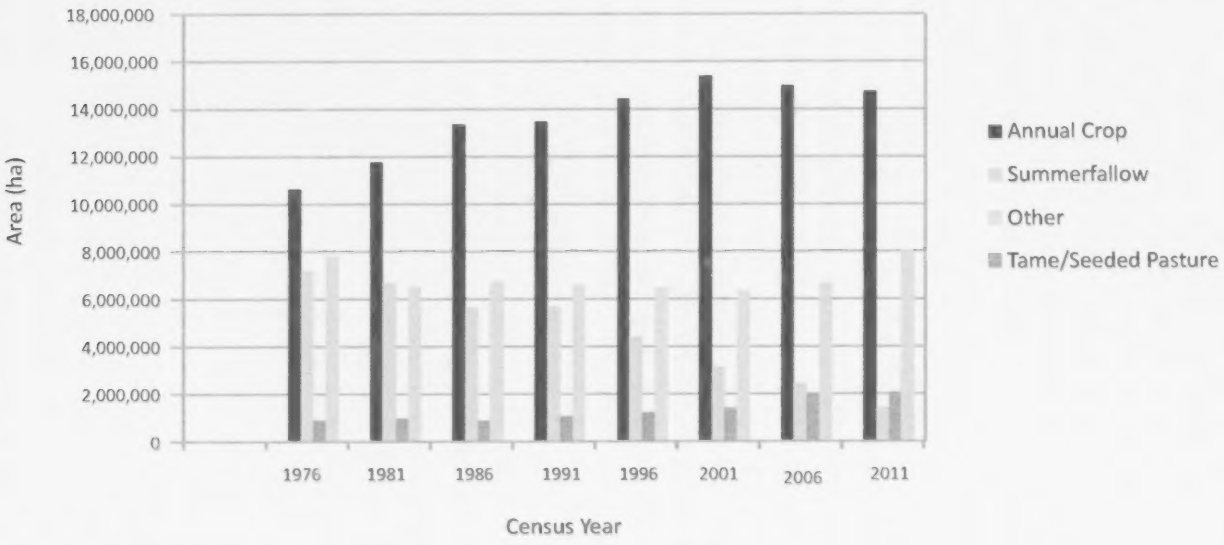
Just as the diversity in forest types reflects forest landscape biodiversity, so do the land cover types in the agricultural areas of Saskatchewan. In general, agro-ecosystem land cover types like annual crops, summerfallow, and tame or seeded pasture support lower levels of native biodiversity than do natural areas like native grasslands, wetlands and woodlands. This is not surprising as the main intent of farming is food or forage production. Examining the status and trends of agricultural land cover and management practices over time provides the ability to track whether the trend is either towards or further away from enhancing biodiversity.

What does this indicator show?

Figure 3.1 shows the area extent of cropland, summerfallow, tame/seeded pasture and other land types in Saskatchewan from 1976 to 2011 (Statistics Canada 2011a). "Other land" types include natural land for pasture and other land including woodlots, marshes and yards.[1]

The amount of farmland devoted to annual cropping has steadily grown through the reporting period, along with a significant decline in summerfallow. The area devoted to tame or seeded pasture has more than doubled from 1986 to 2011 (878,726 hectares compared to 2,057,957 hectares respectively), and has remained constant in recent years, even with the high price of grain. This could indicate that the increased amount of tame or seeded pasture would contribute to the stability of wildlife in southern Saskatchewan. The area in the category of "other land" has remained relatively constant since 1986. The exception is the increase in the "other land" category for 2011. This increase is due to land reported as "too wet to seed" has been classified as "other land" instead of cropland or summerfallow (Statistics Canada 2011a).

Figure 3.1 Land Cover Type on Saskatchewan Farmland, 1976 to 2011



Source: Statistics Canada 2011a

[1]Saskatchewan experienced flooding in the spring and summer of 2011 and land reported to the 2011 Canadian Census of Agriculture as "too wet to seed" has been categorized as "other land" and not cropland or summerfallow; this land could shift back to cropland when conditions improve. Saskatchewan reports land "too wet to seed" as summerfallow.

Figure 3.2 Area of Land Under Summerfallow in Saskatchewan, 1916 to 2012

Note: The increase in summerfallow hectares in 2010 and 2011 is due to abnormally wet growing seasons that resulted in land that couldn't be seeded because of excess water, and is reported by the Ministry of Agriculture as summerfallow (refer to Footnote for difference in reporting by Statistics Canada).

Source: Saskatchewan Ministry of Agriculture 2012

A closer examination shows changes in the area of summerfallow on Saskatchewan farmland from 1916 to 2012 (Figure 3.2) (Saskatchewan Ministry of Agriculture 2012). The area of farmland devoted to summerfallow steadily increased up to the 1960s and 1970s, and has declined ever since. In fact, according to Statistics Canada, summerfallow as a proportion of total farm area in Saskatchewan decreased to 5.8 per cent in 2011 from 9.3 per cent in 2006. Its decline is associated with the growing awareness of summerfallow's negative environmental effects such as soil erosion, soil organic depletion and increased soil salinity. It is estimated that up to 50 per cent of the soil's organic matter had been lost in Saskatchewan since cultivation began and before the uptake of more sustainable practices such as conservation tillage and zero-tillage (Saskatchewan Ministry of Agriculture 2011).

What actions are being taken?

Farmers in Saskatchewan are broadly adopting alternatives to summerfallow, such as zero-till. The organic matter of Saskatchewan's farmland soils is now being actively restored (West and Post 2002), resulting in higher levels of agri-environmental health. Various permanent cover programs have also contributed to some cropland being re-seeded back to grass. The Ministry of Environment continues to successfully address the pressures on natural areas like wetlands, woodlands, and native grasslands continue and are supportive of collaborative conservation efforts like the Prairie Conservation Action Plan (PCAP 2010).

3.2 Stressor Indicator: Mineral Disposition Activity

Why is this indicator important?

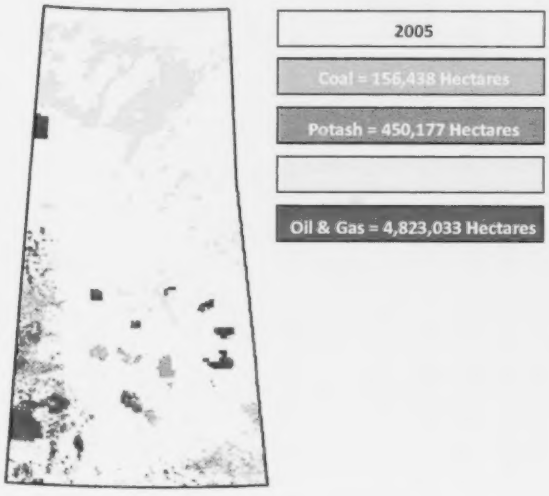
The development of Saskatchewan's non-renewable resources is critical to its future growth and economic wellbeing. For example, mining companies operating in the province made Saskatchewan the highest mineral-producing jurisdiction in Canada in 2008, with production valued at a record $9.7 billion. In 2011, Saskatchewan continued this trend to be a leading mineral producer with production valued at $9.2 billion, the second highest in Canada, and accounting for 18 per cent of Canada's mineral output (Saskatchewan Mining Association 2012). Mining is therefore a major contributor to Saskatchewan's economy, directly contributing over $2 billion in revenue to the provincial government and creating 30,500 jobs in the process. Other important industrial activities in the province include forestry, oil and natural gas. The key to the management of these economic activities is corporate social and environmental responsibility coupled with effective government environmental controls.

What does this indicator show?

Figures 3.3 and 3.4 illustrate the geographic growth of industrial activity between 2005 and 2011 in Saskatchewan as reflected by the sale of sub-surface mineral leases (Saskatchewan Ministry of the Economy 2012). Figure 3.5 shows the value of these Crown land sales for mineral exploration and development from 1968 to 2012 (Saskatchewan Ministry of the Economy 2013).

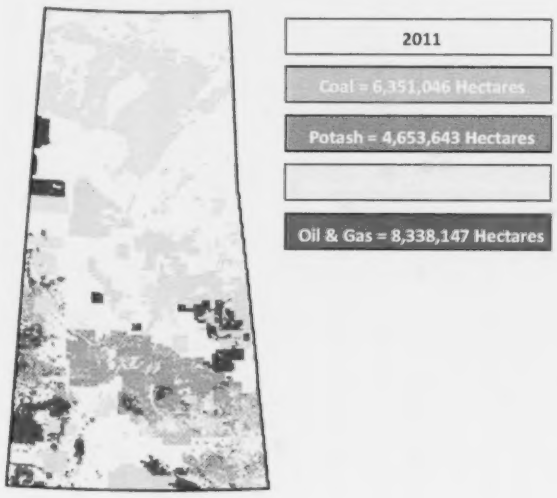
The disposition of minerals is an indicator of interest in Saskatchewan's mineral resources. This, in turn, may lead to exploration and possible industrial activity and expansion. From an ecological perspective, industrial activities can be classified as either intensive or extensive. An example of intensive activities is mining, in which very little land surface is actually disturbed during the process, and an example of extensive activities is natural gas development, in which many well sites can be distributed across a much larger area than is occupied by a single mine site. In both types of industrial activity, developments such as the creation of new roads and trails are of concern, particularly for their cumulative implications for biodiversity, habitat fragmentation and the spread of non-native species.

Figure 3.3 Mineral Disposition Activity in Saskatchewan as of December, 2005



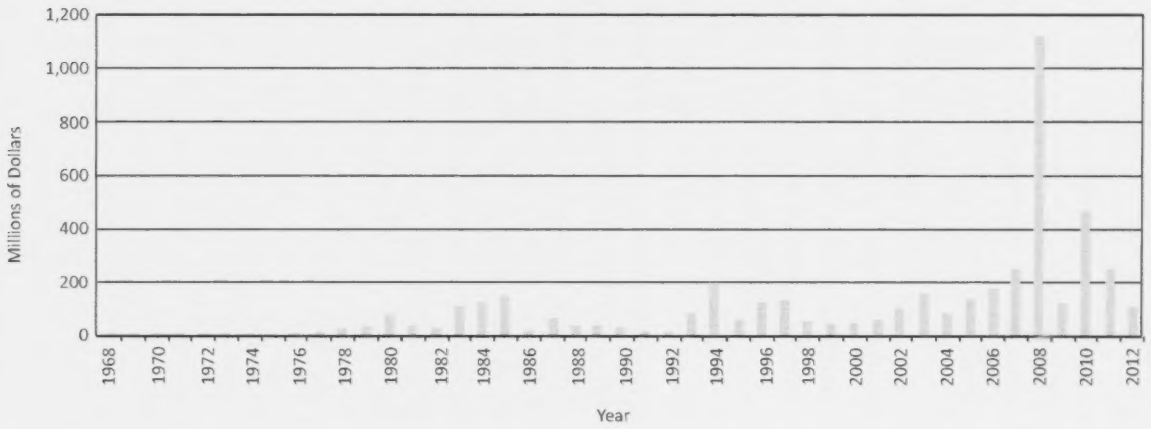
Source: Saskatchewan Ministry of Economy 2012

Figure 3.4 Mineral Disposition Activity in Saskatchewan as of December, 2011



Source: Saskatchewan Ministry of Economy 2012

Figure 3.5 Value of Crown Land Sales in Saskatchewan, 1968-2012



Source: Saskatchewan Ministry of Economy 2012

What actions are being taken?

All industrial activities are governed by both federal and provincial acts and regulations. These acts and regulations determine the province's expectation for the approvals process, licensing and permitting, and operations. For mining, Saskatchewan's environmental regulatory responsibilities are administered through *The Environmental Assessment Act, The Environmental Management and Protection Act, 2002* (as being updated through *The Environmental Management and Protection Act, 2010)*, and *The Mineral Industry Environmental Protection Regulations, 1996* (Wittrup and Murphy, 2012).

Environmental stewardship and sustainability are important to industry. The various non-renewable resource industry sectors in Saskatchewan employ environmental practitioners at their operations throughout the province, and invest in researching, predicting, monitoring, preventing and mitigating their effects on the environment. Environmental stewardship is a part of industrial planning from conception to production through to reclamation and decommissioning. For example, under *The Reclaimed Industrial Sites Act, 2007* all mining, forestry and energy companies are required to incorporate reclamation and/or restoration and decommissioning plans as part of their Environmental Impact Statements that are submitted to the Ministry of Environment prior to development. Major plans go through a thorough public review process before approvals are issued. As part of approvals issued under *The Mineral Industry Environmental Protection Regulations 1996,* mines are required to provide financial assurance to the Ministry, so that decommissioning and reclamation work can be completed without impact to provincial taxpayers. *The Environmental Management and Protection Act, 2010* will extend this requirement to non-mining industrial operations where warranted.

On the exploration side, industry continues to show leadership. For example, the Prospectors and Developers Association administers the Environmental Excellence in Exploration initiative (e3). This is an unparalleled online resource of data and environmental management practices designed to promote and ensure that the highest levels of environmental stewardship are practiced on mineral exploration projects worldwide (Prospectors and Developers Association of Canada 2013).

3.3 Response Indicator: Area Under Zero-Tillage

Why is this indicator important?

Adoption of conservation farming practices like zero-tillage is producing significant improvements to Saskatchewan's air and water quality, biodiversity conservation and soil carbon storage (Hofmann 2008, Wicklum and Gray 2010). Conventional tillage, conservation tillage and zero-till (or no-till) are defined by the amount of crop residue left on the ground (Hofmann 2008). Crop residue is the vegetative material, often referred to as trash or litter, left after a crop has been harvested. It can include straw, stubble, leaves and stalks.

Seeding that involves direct seeding into crop residue/soil is known as zero-till or no-till. The zero-till approach avoids any mechanical tillage of the soil and attempts to keep soil disturbance to an absolute minimum. In contrast to the multiple passes of equipment in the conventional approach, and the minimal tillage of conservation tillage, zero-till can involve just one pass through the fields for planting.

The greater the level of tillage, the greater the loss of soil organic matter. Organic matter is important for supporting soil biodiversity such as bacteria, fungi and earthworms that help cycle nutrients and increase the speed of pesticide breakdown. Organic matter also stores carbon, thus zero-till also provides substantial climate change benefits. By lowering the number of passes through the fields with conservation tillage or zero-till, farmers gain savings in fuel and labour. Nationally, total fuel expenditures and repair costs on farms using zero-till systems were approximately one third of those in typical conventional tillage (Hofmann 2008). Reduced use of fuel not only lowers farmer costs, but also reduces air pollution and greenhouse gas emissions.

Minimizing tillage also supports climate change adaptation. Increased soil organic matter levels enhance moisture-holding capacity and reduce vulnerability to soil erosion. Improved soil health increases agriculture's resilience through severe droughts and extreme weather events and enables sustained productivity over the long term.

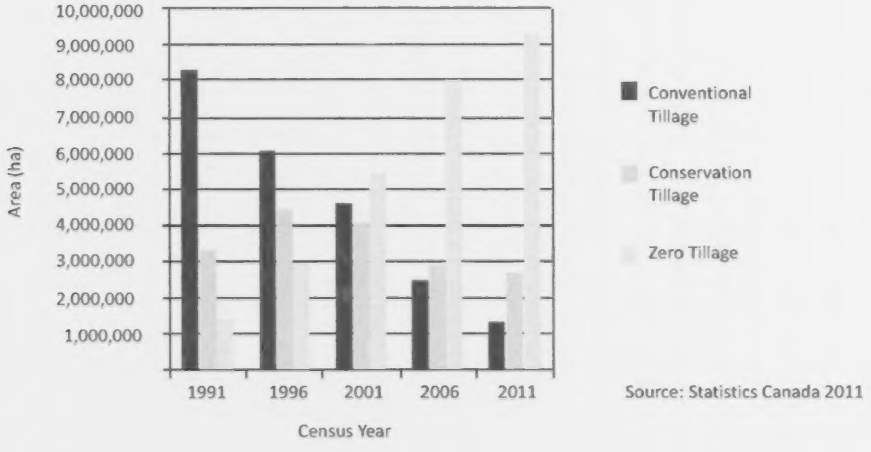
What does this indicator show?

Figure 3.6 shows the successful conversion to zero-till practice on farmland in Saskatchewan from 1991 to 2011 (Statistics Canada 2011b).

There has been a dramatic increase in the adoption of zero-till in Saskatchewan over the reporting period with a simultaneous decline in the use of conventional tillage. The level of conservation tillage has remained relatively unchanged. In Saskatchewan, zero-till was used on 70.1 per cent of the land prepared for seeding in 2011, up from 60.2 per cent in 2006. (Statistics Canada 2011b).

An increase in soil cover over time indicates an improvement in environmental sustainability since the soil is more protected from degradation and is less likely to contribute to water contamination and atmospheric emissions (Eilers et al, 2010).

Figure 3.6. Area of Land Under Zero Tillage in Saskatchewan, 1991-2011



Source: Statistics Canada 2011

What actions are being taken?

The Saskatchewan Soil Conservation Association (SSCA) continues to advocate for the increased adoption of zero-tillage (SSCA 2010). The SSCA and individual farmers' efforts, along with the rising costs in fuel, will likely mean that zero-till will continue to gain popularity across Saskatchewan to the benefit of agricultural ecosystems.

3.4 Response Indicator: Private Land Stewardship

Why is this indicator important?

Land management activities by private conservation organizations and individuals are a key component of sustainable land and water management. These conservation stewards play an important role, not only in maintaining and conserving natural areas through their activities, but also in providing social and economic benefits to the people of Saskatchewan as a whole.

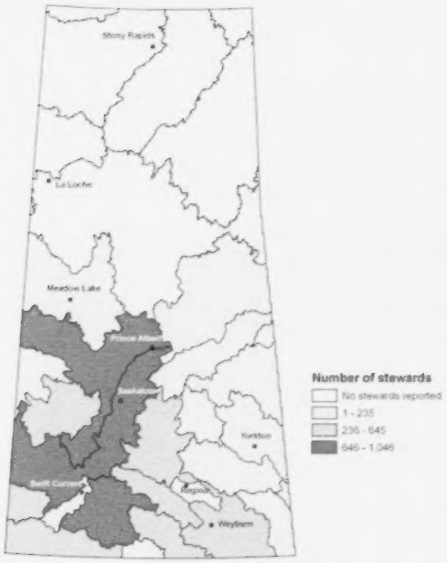
What does this indicator show?

Private land stewardship in this indicator is the status of Water Security Agency voluntary conservation agreements with private land owners for improved and acceptable management of land and farming operations near riparian areas, stream banks, etc. Figures 3.7 and 3.8 show the number of voluntary private conservation stewards in Saskatchewan by watershed for 2008 and 2012 respectively. Figures 3.9 and 3.10 show the number of hectares covered under conservation agreements by watershed for 2008 and 2012 respectively (Saskatchewan Watershed Authority 2010, Water Security Agency 2013). Refer to Figure 5.1 on page 59 for watershed names. For both 2008 and 2012, the number of conservation stewards and the hectares covered under conservation agreements is the combined total of the stewards in the Prairie Stewardship Program, the Permanent Cover Programs I and II, and the Greencover Canada Programs. Further information on these programs can be found in the *State of the Watershed Report, 2010*; Appendix C - Response Indicators, Page 24 (Saskatchewan Watershed Authority 2010). The Greencover Canada Programs also reflects the hectares conserved through conservation steward agreements with Ducks Unlimited Canada.

The number of voluntary conservation stewards in 2012 is greatest in the North Saskatchewan River, Old Wives Lake, South Saskatchewan River, and Upper Qu'Appelle River watersheds (Figure 3.8). This is an increase of one watershed (Upper Qu'Appelle River) compared to the number of conservation stewards by watershed recorded in 2008 (Figure 3.7). The number of hectares covered under conservation agreements in 2012 is greatest in the Big Muddy Creek, Carrot River, Milk River, Moose Jaw River, North Saskatchewan River, Old Wives Lake, Quill Lakes, South Saskatchewan River, Upper Qu'Appelle River, and Upper Souris River watersheds (Figure 3.10). This is an increase of five watersheds (Milk River, Moose Jaw River, Quill Lakes, Upper Qu'Appelle River, Upper Souris River) compared to the number recorded in 2008 (Figure 3.9).

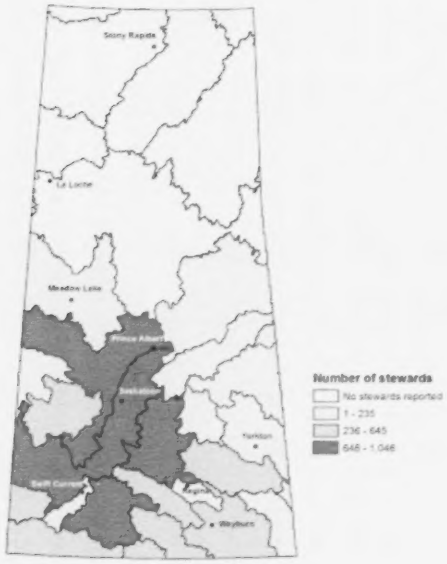
Further information on this indicator, detailing agreements and hectares covered by these voluntary land stewardship programs, can be found in the *2010 State of the Watershed Report* (Saskatchewan Watershed Authority 2010).

Figure 3.7 Number of Conservation Stewards in Saskatchewan by Watershed: 2008



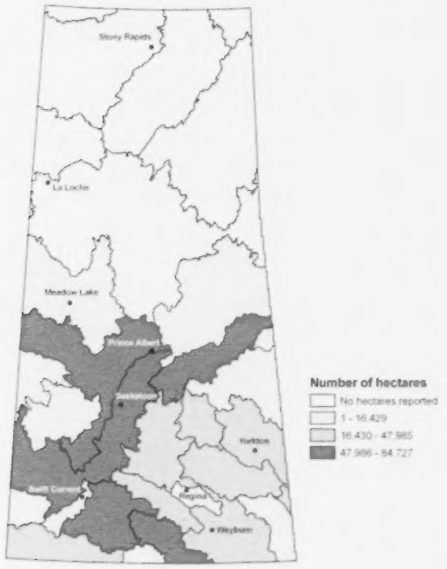
Source: Saskatchewan Watershed Authority 2010

Figure 3.8 Number of Conservation Stewards in Saskatchewan by Watershed: 2012



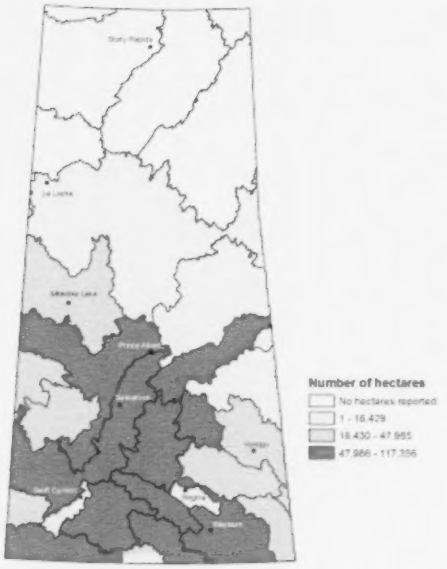
Source: Saskatchewan Water Security Agency 2013

Figure 3.9 Area Covered Under Conservation Agreements in Saskatchewan by Watershed: 2008



Source: Saskatchewan Watershed Authority 2010

Figure 3.10 Area Covered Under Conservation Agreements in Saskatchewan by Watershed: 2012



Source: Saskatchewan Water Security Agency 2013

What actions are being taken?

Information included in the Private Land Stewardship Indicator is based on agreements between the Water Security Agency and owners of private land in the agricultural areas of Saskatchewan.

Additional private land conservation efforts, undertaken by environmental stewardship groups, contribute to the environmental wellbeing of the province. For example, various agencies use partnership agreements with land owners in the form of a conservation easement to formally designate and protect areas. The current total number of hectares in conservation easements in Saskatchewan as of December 2012 is approximately 92,800 hectares (Saskatchewan Ministry of Environment 2013a); an increase of over 6,500 hectares since 2010 as reported in Saskatchewan's *2011 SoE* (Saskatchewan Ministry of Environment 2011).

The Representative Areas Network (RAN) and Land Use Planning

Ministry-led conservation efforts, such as the Representative Areas Network (RAN), are also a key component to land stewardship in the province. The RAN is intended to conserve representative and unique landscapes throughout the 11 ecoregions of the province to maintain ecosystems that support native biological diversity. The Government of Saskatchewan is committed to recognizing 12 per cent of the provincial landscape in the RAN. The RAN includes designated Crown lands that have been given a level of protection by legislation and private lands that are managed for biodiversity by agreement, for example under a conservation agreement. These representative areas conserve biodiversity in a variety of recognized conservation lands such as parks, ecological reserves, and pastures and act as benchmarks for measuring environmental change and ecological health.

The Ministry of Environment continues to identify, protect and manage sites within the provincial Representative Areas Network. There are currently 5.96 million hectares, or approximately nine per cent of the province, in the RAN. The number of hectares has remained unchanged since 2004; however, a number of sites have been identified within integrated land use plans. Land use planning processes, led by the Ministry, informs development and resource allocation decisions that are supported by First Nations and Métis communities, as well as diverse stakeholders and user groups. There are currently 10.4 million hectares of Crown resource land under approved land use plans with an additional 3.9 million hectares undergoing planning processes. As these land use plans are approved and recommendations for designation of proposed representative areas are implemented, more hectares will be added.

As an example, in May 2012, the Government of Saskatchewan adopted the Misinipiy Integrated Land Use Plan. This plan identifies new protected areas in the north central area of Saskatchewan and work is underway to designate the Pink Lake Representative Area Ecological Reserve. Once designated, the Pink Lake site will be the largest provincially designated protected area in the Saskatchewan, consisting of approximately 366,000 hectares, nearly the size of Prince Albert National Park.

3.5 Response Indicator: Waste Recycling

Why is this indicator important?

Diverting waste before it reaches landfills is an important way to reduce its impact on the environment. Much of what used to be called 'trash' or 'waste' is a valuable resource that can be re-used for environmental, social and economic benefits. Less waste means fewer landfills, less pressure on our natural resources, reduced risk from harmful chemicals, lower carbon emissions, as well job and wealth creation.

What does the indicator show?

Figure 3.10 shows the proportions of various materials recycled in Saskatchewan from 2001 to 2012. In general, recycling rates in Saskatchewan are high and have remained so over the reporting period, with increasing rates in recovery for oil filters and oil containers. SARCAN Recycling has recycled almost 5.7 billion deposit-paid beverage containers since it opened its doors in 1988 (SARCAN Recycling 2013). The Ministry is proud to report that, in 2011 to 2012, 87 per cent of all deposit-

paid, ready-to-serve beverage containers sold in Saskatchewan were recycled, which makes this the highest return rate of all beverage container programs in Canada.

Over the last decade, the Saskatchewan Scrap Tire Corporation (SSTC) has been delivering a province-wide tire recycling program. In 2011, over 41 million pounds (776,269 tires) were collected through the program for recycling. Since SSTC began operating in 1996, 18 million tires have been diverted from landfill disposal, 300 landfill tire stockpile sites have been cleaned up, and private tire stockpiles in 48 municipalities have also been cleaned up (SSTC 2013).

CleanFARMS Inc.'s Pesticide Container Collection Program provides consumers, mainly agricultural producers, with an environmentally safe and convenient way to dispose of empty pesticide containers. With proper cleaning, these containers can be recycled economically and in an environmentally safe fashion (CleanFARMS 2013). Saskatchewan's agricultural producers generated approximately 1.46 million empty plastic pesticide containers in 2011, lower than the 1.68 million containers collected in 2010. Weather-related issues in Saskatchewan played a role in 2011 resulting in a reduction of containers collected because a large amount of farmland could not be planted, thus reducing the need for pest control products.

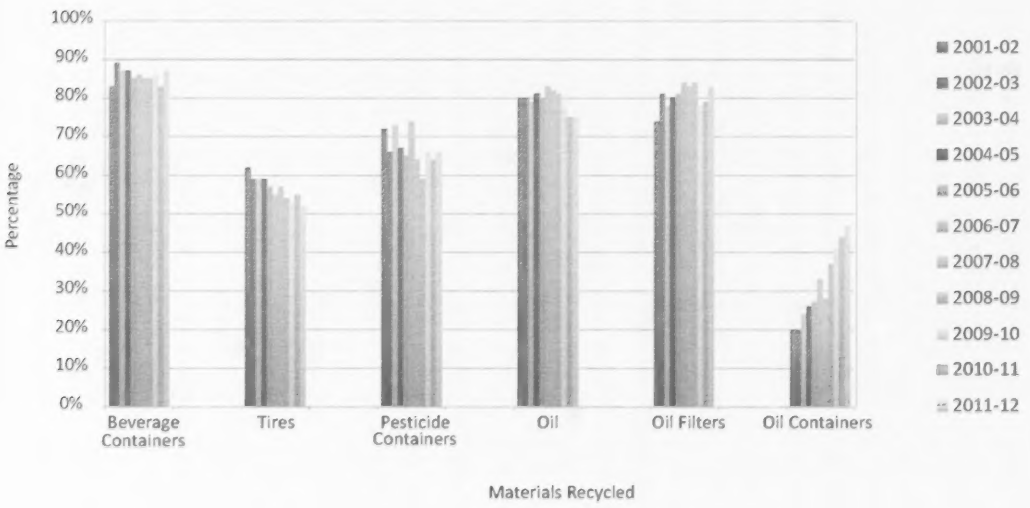
The Saskatchewan Agricultural Stewardship Council (SASC), made up of representatives from the agricultural industry and formed under the CleanFARMS umbrella, has been tasked to develop and implement an agricultural plastics recycling program. Further information on this initiative can be found in Snapshots of Local Responses at the end of this chapter and their website: http://www.cleanfarms.ca/sasc.

The Saskatchewan Association for Resource Recovery Corporation (SARRC) is responsible for recycling used oil materials in Saskatchewan. Since its program began in 1996, 3.5 million kilograms of oil containers, 25.6 million oil filters, and 231 million litres of used oil have been recycled (SARRC 2013).

More recent recycling efforts include electronic waste and paint. Total amounts of electronic waste and paint are provided as recycling rates are not available at this time. The Saskatchewan Waste Electronic Equipment Program (SWEEP) co-ordinates the collection and recycling of obsolete electronic equipment. Between 2007 and 2011, approximately 12,229 tonnes of electronic waste was collected with increasing amounts in consecutive years (SWEEP 2013).

The Saskatchewan Paint Stewardship Program is managed by the paint industry through its non-profit association, Product Care. In 2011, the Saskatchewan Paint Stewardship Program collected 349,660 litres of waste paint. This includes 70,377 litres of paint collected and reused through the program's "Paint Exchange" initiative (Product Care 2013).

Figure 3.10 Proportions of Materials Recycled in Saskatchewan, 2001-2012



Source: Saskatchewan Ministry of Environment, Municipal Branch 2013

What actions are being taken?

Waste recycling in Saskatchewan is growing each year thanks to the efforts of a number of organizations working with local and provincial governments. Additional information is available from Recycle Saskatchewan (2013) and the Saskatchewan Waste Reduction Council (2013).

The Government of Saskatchewan has set the foundation for a province-wide multi-material recycling program (MMRP) with the approval of the Household Packaging and Paper Stewardship Program Regulations announced in February 2013 (Saskatchewan Ministry of Environment 2013b). As the economy continues to grow, reducing the amount of waste going to local landfills will help us to improve our environment and maintain our quality of life. It is estimated that more than 40 per cent of the household waste going to landfills today, amounting to the equivalent of about 112,000 tonnes, can be diverted into recycled products which will create new business and employment opportunities.

The MMRP will provide the framework to fund the collection and recycling of household materials including printed paper, newsprint, cardboard, plastic, metal and glass packaging in the province. With the regulations now in place, Multi-Material Stewardship Western Inc. (MMSW), representing industry, will work with municipalities and other stakeholders to develop the recycling program.

Snapshots of Local Responses

CleanFARMS and the Saskatchewan Agricultural Plastics Stewardship Initiative

As the agricultural industry grows in Saskatchewan, there's a pressing need to expand recycling programs to incorporate agricultural plastics such as plastic grain bags, plastic twine, silage bags and bale wrap. Currently, agricultural producers have very few options available to properly handle and dispose of these plastic materials. At the same time, producers are very supportive of recycling programs; like the industry-led empty pesticide container program that has operated in the province for more than 20 years. CleanFARMS, a non-profit industry stewardship organization committed to environmental responsibility through the proper management of agricultural waste, is being funded by the Ministry of Environment to support the work necessary for an industry-led recycling program. The Saskatchewan Agricultural Stewardship Council (SASC), made up of representatives from the agricultural industry and formed under the CleanFARMS umbrella, has been tasked to develop and implement an agricultural plastics recycling program. This development builds on a successful recycling pilot program funded by the Ministry of Agriculture and operated by the Provincial Council of Agriculture Development and Diversification Boards and the Moose Jaw River Watershed Stewards (MJRWS). Since 2011, approximately 83,000 kilograms of agricultural plastic has been recycled as a result of the pilot program. SASC is now consulting with farm organizations, municipalities, environmental groups, manufacturers, distributors, plastics recyclers and waste haulers to develop an environmentally responsible and cost effective program to collect and manage agricultural plastic. This stewardship approach is consistent with other successful industry-led recycling programs in Saskatchewan, such as electronic waste, scrap tires, used oil and waste paint.

Native Plants in the Classroom

Native Plants in the Classroom is a project designed to connect youth with nature. This Native Plant Society of Saskatchewan (NPSS) initiative will educate and involve youth across Saskatchewan in native plants and habitats (including species at risk) through classroom and outdoor exercises, teacher resources, and other events. The NPSS will adapt, compile and produce educational materials concerning native plants and habitats. A teacher resource kit will also be created which will contain detailed lesson plans, native seeds to plant, printed resources such as booklets and posters, and electronic media such as a teacher/student resource page on the NPSS website. Many schools groups have already participated in events, both in the field and in the classroom, with more than 1,000 native seed packets distributed. For more information on the project, the NPSS can be contacted at http://www.npss.sk.ca.

Making Connections with Biodiversity

Habitat fragmentation of natural landscapes into small and isolated patches is one of the greatest threats to biodiversity. Landscape corridors provide a critical function in facilitating biodiversity movement in and out of fragmented patches of land. The selection of conservation lands on the basis of landscape connectivity represents an entirely new approach to on-the-ground conservation in Saskatchewan. This innovative approach and project is being supported by the Go Green Fund. Project partners include the Nature Conservancy of Canada (NCC), the Saskatchewan Wildlife Federation (SWF) and Environmental Systems Assessment Canada. A landscape connectivity model to identify movement corridors has been selected, fine-tuned and evaluated. Analysis has shown that this modeling approach is useful in pinpointing important habitats that function as biodiversity corridors. This in turn will help in the selection and purchase of new conservation lands within these corridors. SWF and NCC have already secured new conservation lands in habitats identified by the model.

Highlights for Land

Various land uses and management practices determine the current status of land health and environmental sustainability in Saskatchewan. Changes in land use influence whether the trend is either towards or away from enhancing biological diversity. The key to maintaining the health of the environment is the sustainable use of our resources through greater integration between our economy and the ecosystems that support it. The soil conservation story is an excellent example of how this can and is being achieved, as illustrated by the agricultural land cover condition indicator and zero-till response indicator. A substantial increase in soil cover, with the resulting benefits of increased organic matter and soil biological diversity, indicates an improvement in environmental sustainability in both agricultural land and adjacent natural areas. Healthy soils not only benefit farmers and the environment, but also ultimately our society as well.

The pressures on Saskatchewan's land are high and could increase with future industrial development as shown by the increase in mineral leases in the province. Continued industry leadership and innovation in environmental sustainability is required, in partnership with current regulatory reform in government, to help the province move towards a result-based approach to environmental management.

Working together is key in both private and public land stewardship, as shown by the efforts of individuals, organizations and government to secure and maintain healthy ecosystems that support native biological diversity. A private stewardship response indicator provides the status of programs that primarily focus on conservation stewards who own and manage private land in the agricultural areas of Saskatchewan. The Representative Areas Network (RAN), a complementary government conservation effort, is also a key component to land stewardship in the province.

Recycling waste is another example where the Government of Saskatchewan and local governments are working together with the private sector to establish recycling industries. Waste recycling in Saskatchewan is available for beverage containers, scrap tires, pesticide containers, used oil, oil filters and oil containers, electronic waste and paint. The province-wide multi-material recycling program will now provide the framework to fund the collection and recycling of household materials including printed paper, newsprint, cardboard, plastic, metal and glass packaging in the province. As well, consultations were initiated in January 2013 to develop an environmentally responsible and cost effective program to collect and manage agricultural plastic.

The status and trend of the five land indicators reported on in this chapter are summarized as follows:

3.1 **Agricultural Land Cover** – Positive agri-environmental conditions exist with a continual decreasing trend in the area of summerfallow and increasing trend in tame or seeded pasture land cover.

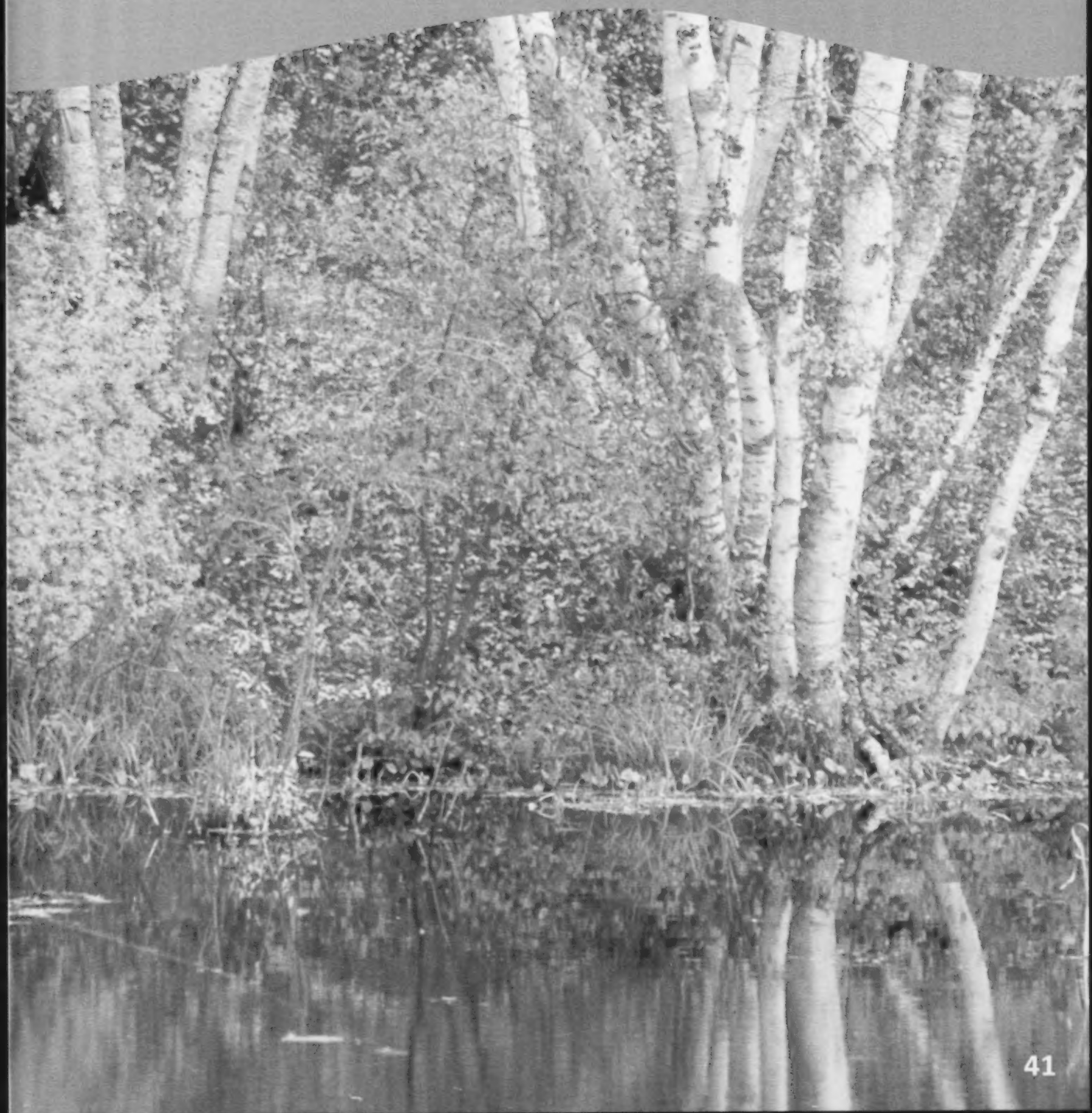
3.2 **Mineral Disposition Activity** – The trend in mineral disposition activity since 2005 has substantially increased as reflected by the sale of sub-surface mineral leases. This trend has leveled off in recent years as reflected by the decreasing value of Crown land sales for mineral exploration and development.

3.3 **Area Under Zero-Till** – Positive agri-environmental conditions exist with a continual increasing trend in zero-till practices and no significant change in conservation tillage. In 2011, 82 per cent of cropland in Saskatchewan was either conservation tilled or zero-tilled.

3.4 **Private Land Stewardship** – Indicator shows a positive environmental response with an increasing trend in both the number of voluntary conservation stewards and the number of hectares covered under conservation agreements as defined by watershed.

3.5 **Waste Recycling** – The news is positive. Recycling rates have been generally steady with increasing rates in recovery for oil filters and oil containers and consecutive increases in recycled electronic waste during the program's five years of operation.

FOREST



Key Points

- Saskatchewan's forests are diverse with all age classes and forest types represented in the forest
- Half of the commercial forest is considered mature to very old
- Natural disturbances, such as wildfire and insect infestations, play a major role in changing the forest landscape
- It is uncertain how climate change will affect natural disturbance regimes
- Since 2007, only 30 per cent or less of the annual sustainable allowable cut was harvested each year
- Approximately 96 per cent of harvested forest areas have been successfully regenerated
- Government forest renewal backlogs have been largely addressed

Forests are an important part of Saskatchewan's economy and environment. Over half of the province is forested, providing many benefits. As stewards of the forest resource, the Government of Saskatchewan is committed to its sustainable management. This means that the Government will balance the human use of the forests for various socio-economic and cultural purposes with the need to protect the long-term health of forest ecosystems (Saskatchewan Ministry of Environment 2009, 2012c).

Saskatchewan forests are also home to many thousands of species of plants and animals within a variety of ecosystems. Boreal forests have ecosystems that are influenced over time by natural disturbances such as insects and disease outbreaks, and wildfires. Maintaining the natural range of ecosystems results in a more resilient forest better equipped to recover from human and natural disturbances.

Indicators for Forest

Condition

4.1 Forest Type and Age Class – Describes the forest diversity of the managed portion of the public forests known as the commercial forest zone, and is intended to track changes in forest ecosystem diversity over time.

Stressor

4.2 Forest Wildfire Disturbance – As one of the dominant natural agent of change in the boreal forest, shaping and reshaping the forest landscape, this indicator tracks wildfire over time.

4.3 Forest Insect and Disease Disturbance – As another major natural agents of change, this indicator tracks the levels of insect and disease disturbances in the boreal forest. Insects such as the eastern spruce budworm *(Choristoneura fumiferana)* are a significant disturbance agent and is a natural part of the ecosystem periodically affecting large areas of the forest.

4.4 Proportion of Sustainable Harvest Level Utilized – Tracks the volume of forest harvested each year compared to a defined sustainable harvest level; a measure of sustainable economic opportunity being realized over time. Forest harvesting is a human disturbance that can affect the forest landscape in both positive and negative ways. However, the area of forest harvested each year is much less than that disturbed by wildfires and forest insects. Forest managers are working to make human disturbances associated with logging to more closely resemble natural disturbances and to maintain sustainable harvest levels.

Response

4.5 Forest Regeneration – Relates to long-term forest productivity as the proportion of timber harvested area successfully regenerated. In other words, the trees are restored in harvested areas to an accepted and measurable standard. Forests that are regenerated successfully are essential to a long-term sustainable flow of wood products and the maintenance of ecosystem diversity and productivity.

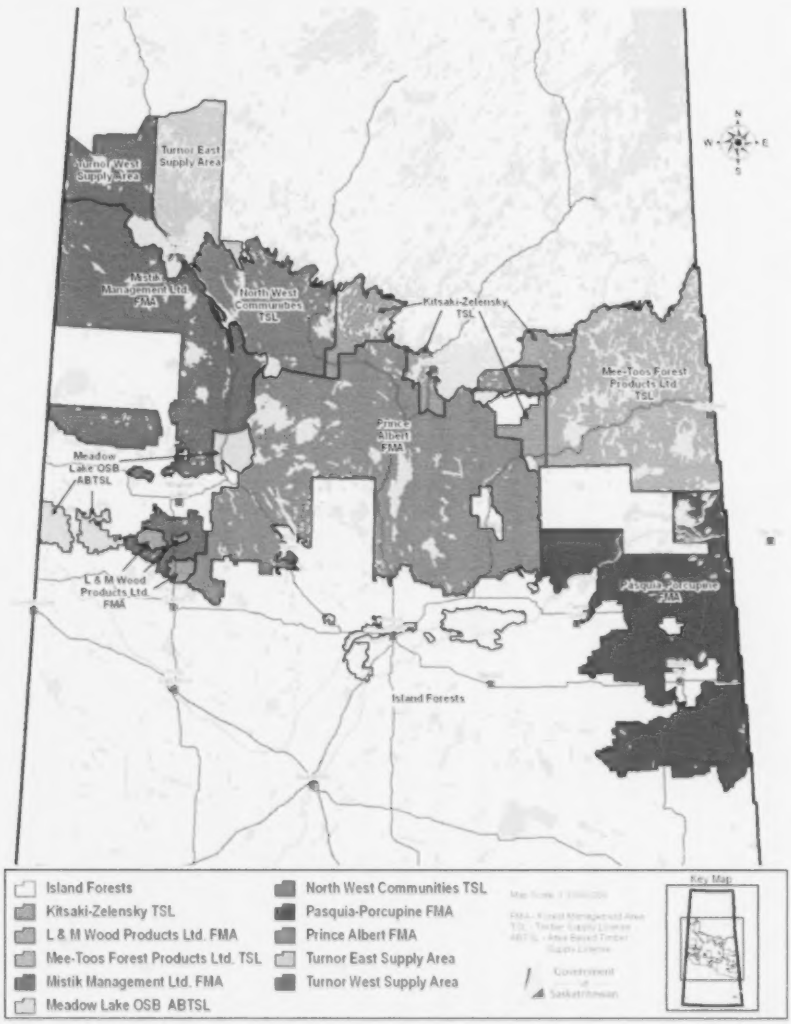
4.1 Condition Indicator: Forest Type and Age Class

Why is this indicator important?

In order to maintain the forest values important to Saskatchewan residents (such as wildlife, pristine mature forests, forest products, forestry jobs etc.) in perpetuity, the natural forest condition and changes to it must be understood and sustainable forest management practices employed.

The Provincial Forest covers the northern half of Saskatchewan, an area of approximately 34.3 million hectares or 53 per cent of Saskatchewan. The area of the Provincial Forest that is viable for timber harvesting and receives the most impacts from human activities is called the commercial forest zone, approximately 11.6 million hectares. This is the area south of the Churchill River and north of the agricultural-forest fringe (Figure 4.1); excluding the Suggi Lowlands and Nemeiben Forest areas, which do not experience commercial forestry activities. The commercial forest zone has a diversity of forest types and ages. Maintaining the natural range of ecosystems results in a more resilient system, helping to sustain overall biological diversity.

Figure 4.1 Commercial Forest Zones in Saskatchewan, 2012



Source: Saskatchewan Ministry of Environment 2013

What does this indicator show?

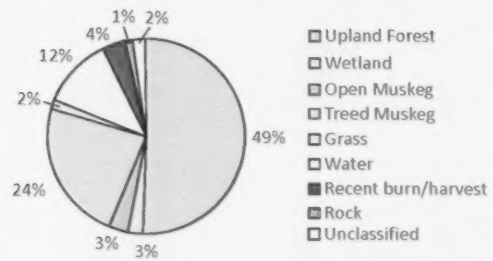
Between 1996 and 2006, forest inventories were completed by forest companies having forest management agreements for approximately 60 per cent of the commercial forest zone. Forest inventories of the remaining 40 per cent of the commercial forest zone were prepared by government during the 1980's, with the exception of the Island Forests which were prepared in the 2000's.

Figures 4.2, 4.3 and 4.4 illustrate the distribution of forest types and forest age classes based on the most recent inventory data. Forest inventories in Forest Management Agreement (FMA) areas are updated periodically as forest companies prepare new forest management plans.

About half of the commercial forest zone is upland forest (forest that is valued for harvesting); while the rest is made up of other ecosystems such as muskegs, wetlands, open water as well as recent disturbances such as wildfire and harvest (Figure 4.2). A diversity of ecosystems exists within the forested portion of the commercial forest (Figure 4.3). This diversity is largely the result of differing soils, moisture regimes and previous disturbance history, mostly natural but sometimes human-caused. The three most abundant forest types are: black spruce–tamarack, trembling aspen–birch and black spruce – jack pine. Of the combined hardwood-softwood age of all the forest ecosystems (Figure 4.4), more than half of the commercial forest is currently either mature (70-90 years), old (91-120 years), or very old (120-plus years). Wildfire protection efforts, as described in the next indicator, can be attributed to successful protection of the mature and old forest types at these levels.

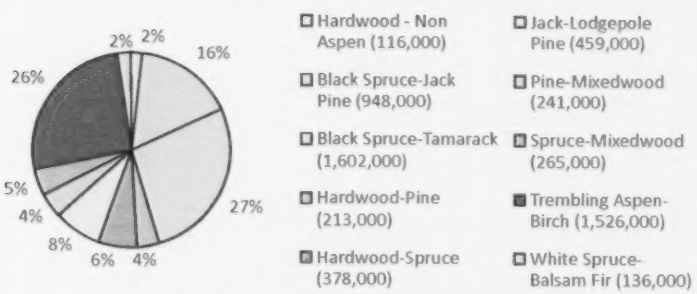
Approximately 127,000 hectares of forest is disturbed over a three year period by various forest replacing disturbance events (Table 4.1). This equates to one per cent of the gross area of the commercial forest zone changing from an immature, mature or old age class to a young age class over a three year period.

Figure 4.2 Forest Inventory Stand Types in the Commercial Forest Zone in Saskatchewan



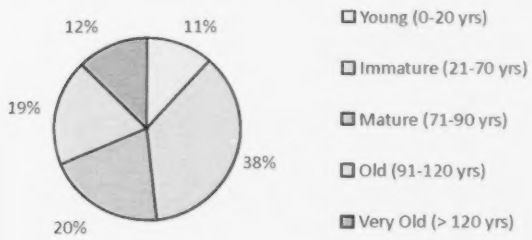
Source: Saskatchewan Ministry of Environment, Forest Service Branch 2013

Figure 4.3 Forest Types (ha) in the Commercial Forest Zone in Saskatchewan



Source: Saskatchewan Ministry of Environment, Forest Service Branch 2013

Figure 4.4 Seral stages of Forest in the Commercial Forest Zone in Saskatchewan



Source: Saskatchewan Ministry of Environment, Forest Service Branch 2013

Table 4.1 Comparing Forest Replacing Disturbance Types on Their Effects on Saskatchewan Forests

Forest Changing Disturbance Type	Operational Year			3 Year Disturbance Total (ha)
	2009/2010	2010/2011	2011/2012	
Blowdown	60	600	51,000	51,660
Wildfire	14,300	30,000	700	45,000
Area Harvested	10,900	9,500	10,000*	30,400
Total (ha)	25,260	40,100	61,700	127,060

*estimated

Source: Saskatchewan Ministry of Environment, Forest Service Branch 2013

What actions are being taken?

The Saskatchewan Forest Vegetation Inventory (SFVI) standard identifies the type, extent and conditions of vegetation, where it exists and what changes are occurring. Government ministries, Forest Management Agreement (FMA) holders, and other clients and partners use the SFVI to assist in decision-making and reporting for various purposes such as forest management, wood supply analysis, carbon modeling, biodiversity monitoring, wildfire management and wildlife habitat classification.

The SFVI requires a certain level of maintenance to account for changes due to harvesting, fire, and other disturbances. The Forest Service Branch is responsible for the annual update of the SFVI to address volume-based Term Supply Licence (TSL) and forest product permit holders' cutblocks within the commercial forest zone. These cutblocks are viewed by satellite imagery (at a 2.5 meter resolution) to delineate and map the changes to the forest to update the forest inventory. The Branch also receives annual spatial data updates from FMA holders to track depletions and renewal areas.

A National Forest Inventory (NFI) was designed in 1997 to provide information to assess the sustainable management of Canada's forests. The NFI is a collaborative effort of Federal, Provincial and Territorial governments from across Canada. The NFI consists of a network of twenty thousand sampling points across Canada. The ongoing 10-year re-measurement cycle provides a continuous record of forest change and consistent information on the state of sustainable development of Saskatchewan's forests and all forests within Canada.

Saskatchewan is managing the provincial forest to a variety of age classes (Figure 4.4) in order to keep the forest healthy and more resilient, as older forests are more prone to insect and disease infestations. Forest management plans contain the strategies for managing age class and other landscape forest values. Approval of forest industry annual operating plans by the Government consider whether the proposed operations on the ground align with commitments to retain seral stages in the forest made in forest management plans.

The Forest Service Branch is working with other provinces and agencies to determine what the historical distribution of age classes and forest types were. Historical distribution is mainly determined by natural change events like fire. This information will be used to set targets for maintaining the composition of forest types within the natural range of variation.

4.2 Stressor Indicator: Forest Wildfire Disturbance

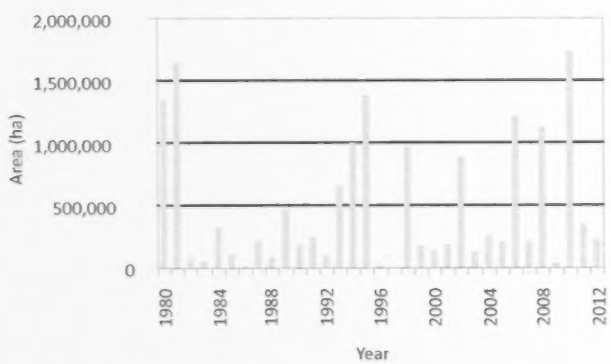
Why is this indicator important?

Forest wildfires are the single largest source of natural disturbance in the boreal forest in Saskatchewan. Over time, they create the mosaic of ecosystems and their associated biodiversity that characterize the forest and provide the template for sustainable forest management. Some experts have predicted that boreal forest wildfire activity may increase due to global climate change (PARC 2010). Indicators like this may be useful to detect these potential changes in the future.

What does this indicator show?

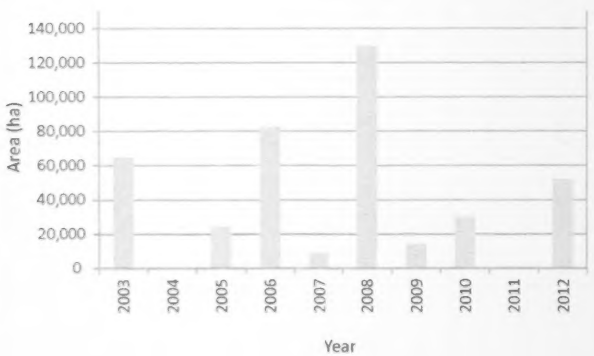
The total amount of area burned by wildfires each year in Saskatchewan is extremely variable (Figure 4.5). In some years, practically nothing burns, and in other years, over one million hectares has been affected. This variability can be largely attributed to annual variation in weather patterns, particularly with respect to precipitation and temperature. The ten year average area burned for the entire provincial forest is 549,519 hectares. Figure 4.6 shows the annual commercial forest zone burned in Saskatchewan from 2003 to 2012. The ten year average area burned in the commercial forest zone is 65,615 hectares.

Figure 4.5 Annual Total Area Burned by Wildfires in Saskatchewan, 1980-2012



Source: Saskatchewan Ministry of Environment, Wildfire Management Branch 2013

Figure 4.6 Total Hectares Burned in the Commercial Forest Zone in Saskatchewan, 2003-2012



Source: Saskatchewan Ministry of Environment, Wildfire Management Branch 2013

What actions are being taken?

The Wildfire Management Branch of the Ministry of Environment has adopted a number of wildfire management strategies (Saskatchewan Ministry of Environment 2010) in conjunction with Wildfire Management Strategy Zones (Figure 4.7) (Saskatchewan Ministry of Environment 2012a). The objectives of the management strategies are to continue to protect the things people value, while allowing fire to play a more natural and beneficial role on the landscape and reducing the extreme costs sometimes associated with managing all forest wildfires.

The Wildfire Management Strategy Zones direct the way the province responds to wildfires and many factors are considered when deciding what actions to take on any particular forest fire. The Ministry of Environment believes that healthy, vibrant forests that are naturally renewed by fire, or through forest harvesting practices that approximate the disturbance created by wildfire, are in the best interest of northern residents, businesses and the Province. However, aggressive protection from wildfire is sometimes the only appropriate action, such as around northern communities. The commercial forest zone also receives significant protection from wildfire.

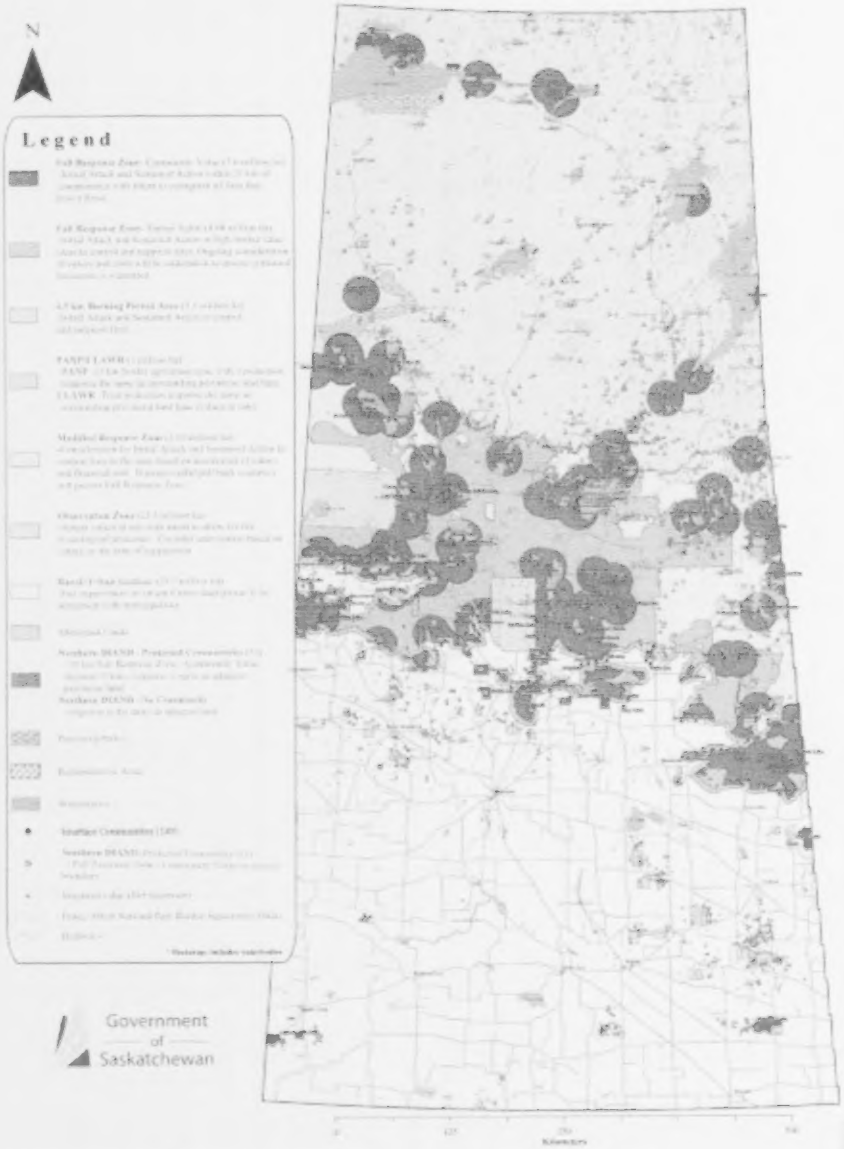
New forest fires are mapped every year (Figure 4.8), creating a database of landscape disturbances caused by fire in northern Saskatchewan for more than 60 years (Saskatchewan Ministry of Environment 2012b). This is an important planning tool for predicting future forest fires, timber volume allocations and wildlife management.

Other elements of the wildfire strategy include: daily public reporting of the current status of wildfires provincially during the fire season, fire bans during periods of high fire risk, the operation and maintenance of weather and fire observation towers, wildfire education and prevention, and aviation operations.

Current projects underway that will improve program delivery include the implementation of an automated burn permitting system to be used by the public and development of a fully integrated wildfire information system that will include automated dispatch and resource tracking.

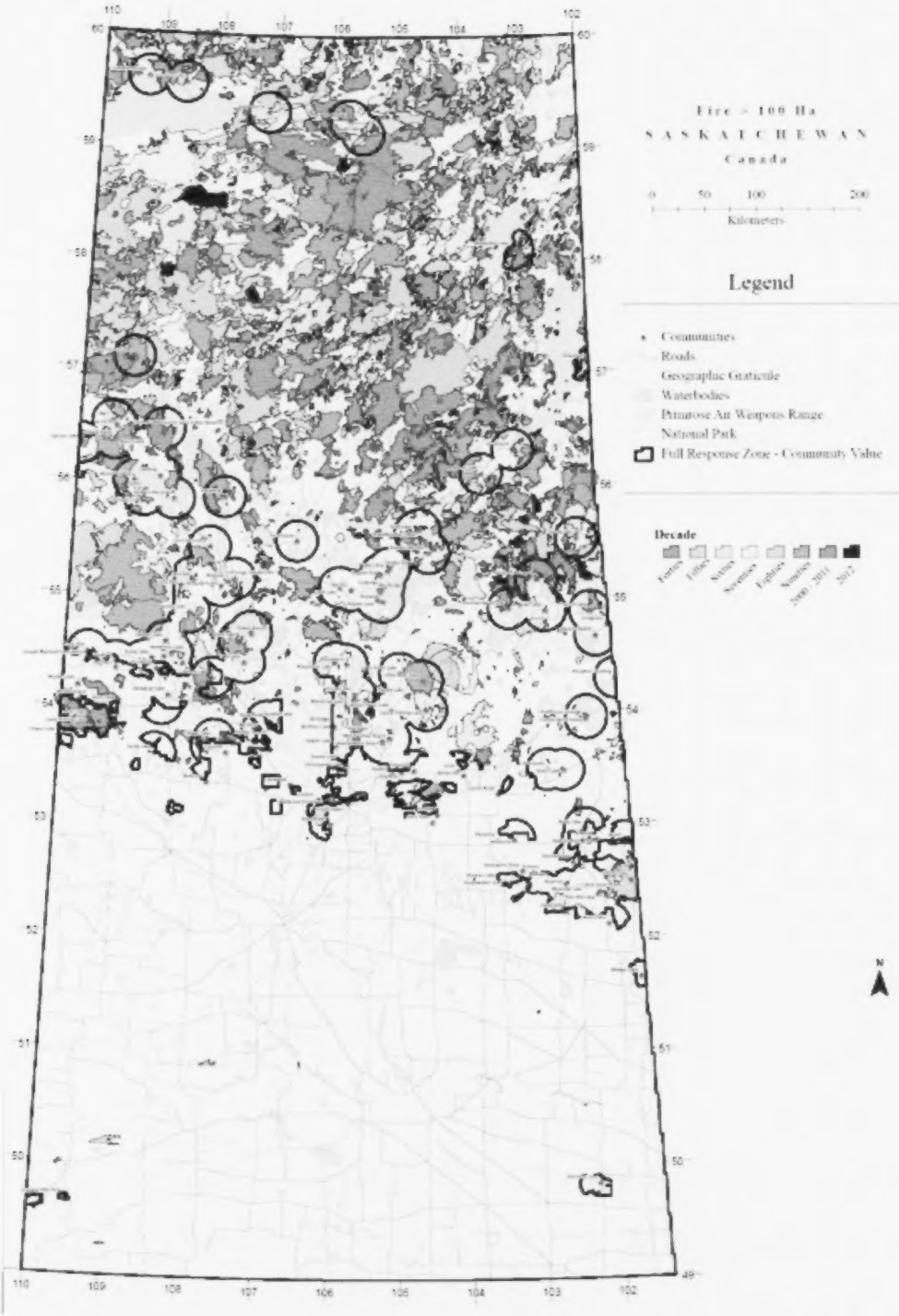
Current capital infrastructure projects include Fleet Renewal, and the Southend Fire Base re-development with both Cypress Hills and Dorintosh re-development projects completed in 2012.

Figure 4.7 Wildfire Management Strategy Zones in Saskatchewan, 2012



Source: Saskatchewan Ministry of Environment, Wildfire Management Branch 2013

Figure 4.8 Wildfire History in Saskatchewan, 1945-2012



Source: Saskatchewan Ministry of Environment, Wildfire Management Branch 2013

4.3 Stressor Indicator: Forest Insect and Disease Disturbance

Why is this indicator important?

Disturbance to Saskatchewan's forests by various insects and diseases also plays a significant role in forest composition and structure, and has a significant impact on sustainable forest management when there are outbreaks. There are a number of native species that serve as agents of change in the forest, such as forest tent caterpillar *(Malacosoma disstria)*, large aspen tortrix *(Choristoneura conflictana)*, eastern larch beetle *(Dendroctonus simplex)* and eastern spruce budworm *(Choristonerua fumiferana)*. Eastern spruce budworm is a major insect pest that disturbs and damages spruce forests in Saskatchewan. Repeated moderate and severe defoliation by this caterpillar kills trees.

Associated with this disturbance regime, climate change and changes in annual weather patterns may be affecting the numbers and distribution of native and invasive forest pests. Range expansion and changes in biology and the timing of life cycles may cause their effects to be greatly magnified over time (Logan and Powell 2004).

In addition to spruce budworm, the most significant and potentially devastating forest insect threat is mountain pine beetle *(Dendroctonus ponderosae)*, which is presently only found in Saskatchewan in the Cypress Hills area in association with lodgepole pine. In British Columbia this insect has killed millions of hectares of lodgepole pine forest and is moving eastwards, having reached Grande Prairie and east of Slave Lake in central Alberta where there are lodgepole pine and jack pine hybrid trees. Potentially, the mountain pine beetle could kill jack pine forests throughout Saskatchewan and right across to eastern Canada if it continues to spread eastward unchecked and becomes established in Saskatchewan's northern jack pine forests.

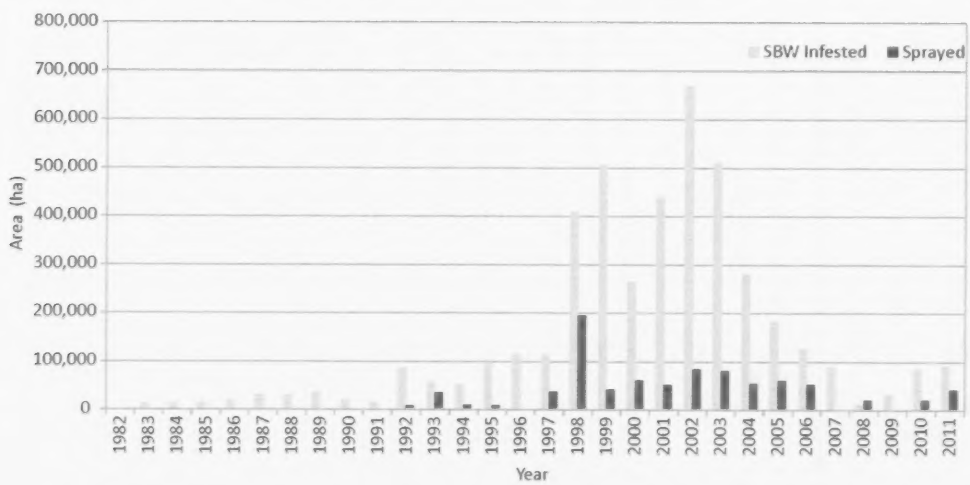
Mountain pine beetles attack pine trees by laying eggs under the bark. When the eggs hatch, the larvae excavate the phloem area beneath the bark and eventually cut off the tree's supply of water and nutrients. The beetles also carry a fungus that causes dehydration and inhibits trees' natural defences against beetle attacks (BC Ministry of Forests, 2012).

What does this indicator show?

Figure 4.9 shows the annual area of forest infested by spruce budworm in Saskatchewan from 1982 to 2011. It also shows the annual area treated with the natural insecticide Btk *(Bacillus thuringiensis kurstaki)* in efforts to manage the outbreak of the insect and to preserve high-value merchantable forest stands.

Spruce budworm is a periodic forest disturbance agent; outbreaks in eastern Canada typically occur on 30- to 35-year cycles. A substantial outbreak of spruce budworm occurred in Saskatchewan between 1996 and 2005. The Ministry of Environment began spraying affected areas with Btk as early as 1992 in hopes of minimizing the area affected. However, the area sprayed is relatively small in comparison to the total area under attack. The infestation reached its peak in 2002 and returned to pre-outbreak levels in 2008. The ten year average of moderate and severe defoliated area within the commercial forest zone is 208,737 hectares.

Figure 4.9 Annual Area Infested by Spruce Budworm and Sprayed, 1982-2011



Source: Saskatchewan Ministry of Environment, Forest Service Branch 2013

What actions are being taken?

Spruce budworm defoliated areas are mapped each July, using aerial surveys followed by ground surveys. Predictions of defoliation for the following year are determined by sampling over-wintering larvae in the autumn. The spruce budworm management program uses specific criteria in selecting areas for treatment, with the objective of keeping economically valuable trees green so they can be harvested within six to 20 years. If required, aerial spraying of the biological pesticide Btk to kill spruce budworm occurs during late May or early June.

Saskatchewan has banned the import, transport and storage of pine forest products with bark attached from British Columbia, Alberta and the United States to reduce the risk of inadvertently transporting mountain pine beetle into Saskatchewan's northern forests.

Mountain pine beetle aerial surveys and ground survey activities have been completed on pine stands within the northern commercial forest and in the Cypress Hills Inter-provincial Park. Fall and burn activities have taken place in the Cypress Hills Inter-provincial Park where lodgepole pine and mountain pine beetle have coexisted.

Pine forest inventory information in the transitional agriculture lands south of the Crown forest has been collected and linked to the provincial inventory so that the extent of susceptible forests can be used in risk analysis.

Saskatchewan and Alberta have entered into a Memorandum of Agreement to implement a coordinated approach to slowing the eastern spread of mountain pine beetle. Under this agreement the province is investing money to combat mountain pine beetle infestations in east-central Alberta to deter the spread into jack pine in Saskatchewan's northern forests.

4.4 Stressor Indicator: Proportion of Sustainable Harvest Level Utilized

Why is this indicator important?

This indicator compares the actual amount of timber harvested to what is sustainably available. The amount available is the maximum sustainable timber volume that can be harvested each year and is referred to in Saskatchewan as Harvest Volume Schedule (HVS), or Annual Allowable Cut (AAC) in other jurisdictions. The HVS is determined for a licence area, based on assessments of economic, social and environmental values as processed through forest estate models over a 200-year timeframe. Keeping the annual harvest level under or equal to the HVS is one of the principles for sustainable forest management.

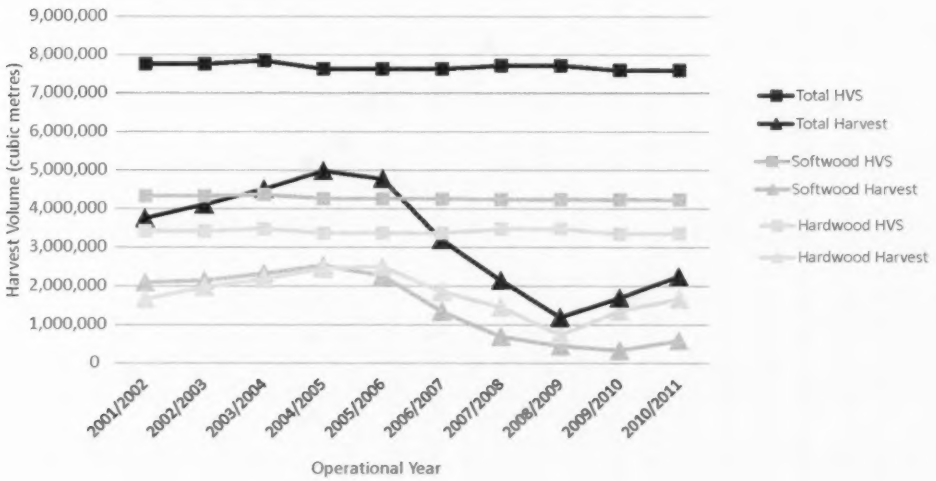
What does this indicator show?

The actual amount of timber harvested each year has been far less than the HVS in recent years (Figure 4.10), largely as a result of depressed forest product markets and the global recession. The total actual volume of timber harvested in Saskatchewan's commercial forests has ranged from 67 per cent (2004/05 operational year) to 15 per cent (2008/09) of the HSV. Actual harvest levels are currently on the rise as the Saskatchewan forest sector rebounds. In 2010/11, the total harvest volume was 2.24 million cubic metres (0.58 million cubic metres of softwood and 1.66 million cubic metres of hardwood), amounting to 29 per cent of the HVS.

The HVS for Saskatchewan's forests has been relatively constant over the last ten years, averaging between seven and eight million cubic metres of timber per year. Each licensed forest area (Forest Management Agreement and term supply licence areas) has an HVS calculated for them. While the forest could sustain this harvest level, in the northern portion of the commercial forest zone the lower quality of wood, higher harvest and transportation costs and limited infrastructure will affect how much of the available volume can be harvested.

The ten year average harvested area within the commercial forest zone is 19,487 hectares per year. In comparison with natural disturbances, the ten year average area burned for the entire provincial forest is 549,519 hectares per year (Figure 4.5), 65,615 hectares burned per year in the commercial forest (Figure 4.6) and 208,737 hectares per year of commercial forests infested by spruce budworm (Figure 4.9).

Figure 4.10 Harvest Volume Schedule (HVS) and Actual Harvest in Saskatchewan, Operational Years 2001/2002 to 2010/11



Source: Saskatchewan Ministry of Environment, Forest Service Branch 2013

What actions are being taken?

The Ministry of Environment supports the efforts by the Ministry of Economy's Forest Development Division to revitalize the forest industry with the long-term goal of full utilization of the HVS.

A new standard is under development under the Saskatchewan Environmental Code for 20-year forest management plans, which will ensure sustainable harvest levels are consistent with long-term management objectives for a variety of environmental, economic and social forest values. For the first time, these code standards will set the parameters for modeling the future forest condition based on its current state and all factors that significantly influence the forest over time. Consequently, there will be an improvement to the accuracy of long-term wood supply forecasts.

Wood supply analyses were completed and harvest volume schedule reports were prepared in 2011 for the North West Communities, Kitsaki-Zelensky and Mee-Toos timber supply zones.

Additional volume in the Prince Albert FMA will be allocated to independent timber operators through a formal request for proposals process. The Forest Service Branch is finalizing the allocation of timber to independent operators through the issuance of Term Supply Licences and permits.

4.5 Response Indicator: Forest Regeneration

Why is this indicator important?

Measures of reforestation are important to show regeneration success in harvested areas considered not sufficiently renewed. Successfully regenerated harvested areas is important to ensure long-term productivity and ultimately their commercial timber value, leading to economic opportunities for northern communities. Improperly renewed forests may also be ecologically different from forests prior to being harvested.

What does this indicator show?

Table 4.2 shows, for each timber license area in Saskatchewan, the area of forest harvested and the proportion that is sufficiently regenerated (SR) following reforestation efforts. Sufficiently regenerated means 80 per cent of the available growing area is occupied with trees at least 30 cm tall at 7 years of age (or 1.5 m tall at 14 years of age). It should be noted that most forests not sufficiently regenerated (NSR) according to this definition are still functioning boreal forest ecosystems, containing significant numbers of trees and wildlife habitats. However, low stocking levels in these areas diminishes their commercial timber value and, for this reason, they are designated as NSR. The table also shows who is responsible for NSR areas.

Overall, 96.8 per cent of harvested forest areas in Saskatchewan have been successfully regenerated. Areas with the lowest proportions of successfully regenerated forests are the Island Forests, especially Fort-a-la-Corne, and the Pasquia-Porcupine FMA area. Most NSR forestlands in the province pre-date the establishment of FMAs and are therefore the responsibility of the Government to restore to SR status.

Table 4.2 Saskatchewan Forest Harvest and Regeneration - March 31, 2012 Status

Licence Area	Harvest Period	Harvest Area (ha)	Sufficiently Regenerated Area (ha)	NSR (ha)	Sufficiently Regenerated Area (%)	Responsibility for Not Sufficiently Regenerated Areas
Pasquia Porcupine FMA[1]	1995-2010	75,404	74,409	500	98.7	Industry
Pasquia Porcupine FMA[1]	Pre-1995	225,231	221,836	4,300	98.5	Government
Prince Albert FMA[1]	1987-2010	156,504	154,000	54	98.4	Industry
Mistik FMA[1]	1984-2008	125,558	124,858	360	99.4	Industry
L&M FMA[2]	1987-2007	8,794	8,794	0	100	Industry
Mee-Toos TSL[2]	1999-2008	3,195	2,767	168	86.5	Industry and Government
Kitsaki-Zelensky TSL[2]	1999-2008	2,645	2,513	132	95	Industry and Government
North West Communities TSL[2]	2002-2008	237	225	12	94.9	Industry
Island Forests[1]	Pre- 2008	28,325	16,466	3,500	58.1	Government
Meadow Lake OSB TSL[2]	2003-2010	4,805	4,805	0	100	Industry
Totals		**630,698**	**610,673**	**9,026**	**96.8%**	

[1] Numbers include regeneration surveys and estimates
[2] Numbers are estimates only
Source: Saskatchewan Ministry of Environment, Forest Service Branch

What actions are being taken?

To complete government renewal obligations on the Pasquia-Porcupine FMA area, stand tending activities, such as thinning, pruning and fertilization, will continue to be undertaken to ensure planted trees to not succumb to competing vegetation.

Remaining renewal responsibilities of the previous Prince Albert FMA holder were determined and have been assumed by the new licensee, Sâkaw Askiy Management Inc.

To address government renewal obligations in the Island Forests, tree planting and site preparation activities commenced in 2011 along with a reassessment of regeneration surveys to better direct renewal efforts in subsequent years. The Island Forest NSR areas are primarily due to a series of fires in the forest in the early 2000s, impacting young plantations. Natural forest regeneration following these fires did not occur, leaving areas that require remedial treatment. The Ministry anticipates that all treatable NSR areas in the Island Forest will be planted over the next few years.

To assess industry performance against forest management plan assumptions and commitments, audits of regeneration surveys have been undertaken on the Mistik and L&M FMAs in 2011/12. This will supplement audits of annually submitted regeneration surveys on other FMAs and Term Supply Licence (TSL) areas. The audit of regeneration surveys within the Prince Albert FMA is currently taking place in 2012/13.

Current standards for regeneration are being incorporated into the new Saskatchewan Environmental Code, to be implemented in the spring of 2013. The code sets out results-based objectives for assessing forest regeneration.

Aboriginal perspectives on climate change and caribou habitat

Since 2008, traditional knowledge among elders and hunters/herders is being gathered on the changing habitat conditions for woodland caribou in northern Saskatchewan and reindeer in northern Sweden. The Prince Albert Model Forest and the University of Saskatchewan, along with the Vilhelmina Model Forest and the University of Umeå in Sweden, are working with indigenous peoples on a collaborative research project in their two respective circumboreal model forests. This project is determining what observations have been made regarding caribou habitat conditions over time, what strategies might help indigenous people adapt to changing climatic conditions and how traditional knowledge might be applied and shared. So far, research results are being shared between the two countries through scientific papers and the creation of an interactive teaching module which will assist resource managers in incorporating traditional knowledge into land management decisions. For more information, contact the Prince Albert Model Forest at http://www.pamodelforest.sk.ca.

Whelan Bay is FireSmart

FireSmart is a nationally recognized campaign to increase awareness of wildfire risk and protection from wildfire. Whelan Bay is working with the Ministry of Environment, Wildfire Management Branch, to learn about wildfire risk and to initiate fuel management projects to make the community more wildfire resilient. The community, on White Swan Lake, borders an over mature coniferous forest. Thinning of mature trees and removal of forest vegetation adjacent to the community was initiated in 2010/2011, and work continues in 2012/2013, to produce a forest buffer that will prevent a high intensity crown fire; giving fire fighters an increased likelihood of firefighting success. Based on high risk locations and community consultation, the Wildfire Management Branch provides opportunities for local forestry contractors to submit proposals, like the Whelan Bay fuel management project, to create wildfire resilient Northern communities. Resources on FireSmart are available from: http://www.environment.gov.sk.ca/firesmart.

Learning about and experiencing Saskatchewan's Forests

The Saskatchewan Forestry Association (SFA) is a non-profit organization that promotes public awareness and education about Saskatchewan's forests. The SFA, with financial support from the Ministry's Forest Services Branch and Wildfire Management Branch, has developed lessons on the Boreal forest for teachers to use in their classrooms. The goal of the SFA is for all students in Saskatchewan to have the opportunity to learn about forests and forest ecosystems. The SFA has made these lessons available, along with a variety of other information, on its website http://www.environment.gov.sk.ca/firesmartwww.whitebirch.ca. To date, there are 59 lessons on the website including 21 for Elementary Schools, 14 for Middle Schools and 24 for High School students. The SFA is also interested in getting young people outdoors to explore the forest environment and draw attention to the details of life in the forest. On request, the SFA is available to lead tours for schools, Girl Guides, the 4H club and church groups.

Highlights for Forest

The condition, stressor and response indicators reported in this chapter can stand alone or be viewed as an integrated package, reflecting the current environmental status of Saskatchewan's forests. Boreal forests are very dynamic ecosystems, constantly changing in response to landscape level natural disturbances such as wildfires and insect outbreaks. As a result, the forest ecosystem landscape becomes a mosaic or patchwork of habitat types. All boreal forest species have evolved in concert with this ever changing landscape.

There is a growing consensus among scientists and foresters that if forest managers more closely emulate the natural pattern and young forest stand structure caused by natural disturbance, there is a reduced risk of creating undesirable effects, such as the loss of forest biodiversity. The Saskatchewan focus on using natural forest patterns to direct forest management creates landscapes that more closely resemble those naturally found in the boreal forest and should provide sufficient habitat for all forest species, including the woodland caribou (Saskatchewan Ministry of Environment 2009).

It is important to understand these patterns on the landscape; hence the need to track the type and age of forest habitat stands as outlined in this chapter. Currently, in the commercial forest zone, there is a diverse mosaic of habitat types reflecting healthy levels of ecosystem diversity. Older forests are present in amounts greater than what would likely occur without human intervention. This is mainly due to several decades of forest fire management and harvest levels lower than the available harvest.

It is also important to understand that natural forces continue to affect the forest, thus the need to monitor and measure the effects of both wildfires and insect damage. Effects of fire, insect and disease disturbances serve to renew vast areas of forest, although the amount varies widely from year to year. The effects of natural disturbances need to be factored into the calculation of the sustainable timber volume that can be harvested each year.

There are opportunities and challenges to improving forest management. The program to replant historic not sufficiently regenerated (NSR) lands is one example where the Government is taking action.

The status and trend of the five forest indicators reported on in this chapter are summarized as follows:

4.1 **Forest Type and Age Class** – A variety of forest age classes are represented in the commercial forest. More than half of the commercial forest is currently either mature (70-90 years), old (91-120 years), or very old (120-plus years). Wildfire protection efforts can be attributed to successful protection of the mature and old forest types at these levels.

4.2 **Forest Wildfire Disturbance** – For 2011 and 2012, the amount of forest burned in the commercial forest zone and forest burned in the entire provincial forest are both below their respective ten-year averages.

4.3 **Forest Insect and Disease disturbance** – Annual area infested by spruce budworm is well below the ten year average. No mountain pine beetle has been detected in Provincial Forests in northern Saskatchewan to date.

4.4 **Proportion of Sustainable Harvest Level** – Since 2007, the amount of timber harvested each year has been far less than the sustainable allowable cut, but is steadily on the rise as the Saskatchewan forest sector rebounds.

4.5 **Forest Regeneration** – Harvested areas are effectively being regenerated.

Today there is great uncertainty in how climate change will affect natural disturbance regimes and forest renewal. Blowdown events, for example, are emerging as a dominant change agent within the forest where snapped and fallen trees are causing difficulty for salvage harvesting and natural or assisted renewal. Government is working with industry to achieve desired future forest outcomes such as productive biologically diverse forests, a sustainable forest sector and a resilient forest in the face of climate change (Saskatchewan Ministry of Environment 2012b, Appendix A).

WATER

Key Points

- Most surface water in Saskatchewan is found in the north, where the demand is lowest
- The majority of Saskatchewan watersheds have good water quality, but eight southern watersheds are considered stressed
- Over 30 per cent of the available surface water is used in one quarter of the watersheds in Saskatchewan; all are in the southern half of the province
- Saskatchewan's per capita water consumption is generally decreasing

One of Saskatchewan's most prized natural resources is our abundant supply of fresh water. More than 12 per cent of its surface is covered by water and seven per cent of Canada's fresh water can be found here. However, most of this water is in the northern half of Saskatchewan where human pressures are low and water supplies are relatively dependable. In the south, where most people live, conditions are semi-arid with a high variability in annual water supply in recent years that has caused situations ranging from drought to flood. As a result, maintaining water quality and a secure water supply is a challenge.

Since 2009, Saskatchewan has been experiencing unprecedented economic and population growth that is expected to continue for years to come. As communities and the economy grow, pressures on water and existing water infrastructure also increase. To be proactive in response to these growth opportunities and challenges, the Government of Saskatchewan announced, in October 2012, the formation of the Saskatchewan Water Security Agency (WSA) and the release of the *25 Year Saskatchewan Water Security Plan*. These are essential steps to address water related challenges of growth and ensure security of our water supplies.

The concept of water security has been developed by water managers around the world over the past 10 years and refers to ensuring sustainable access to the water needed for human health, ecosystem health and the economy. The *25 Year Saskatchewan Water Security Plan* provides direction to achieve water security and the new Water Security Agency has been created as the province's water manager to lead implementation of the Plan.

The WSA brings together all of government's core water management responsibilities, eliminating overlap and improving service delivery through the use of one-window approaches to applications, licensing and program accessibility. The WSA incorporates all of the previous responsibilities of the Saskatchewan Watershed Authority as well as responsibilities for drinking water, wastewater, surface water quality and aquatic habitat transferred from the Ministry of Environment, the East Side Pump Station and M1 Canal water supply system transferred from the Ministry of Agriculture and certain limited scope pipelines transferred from the Ministry of Health.

The *25 Year Saskatchewan Water Security Plan* is a forward-looking document that will ensure the sustainability and quality of Saskatchewan's surface and ground water supplies while protecting drinking water supplies from the source to the tap. The Plan sets out a vision, seven principles, seven goals and 29 action areas. To find out more about the Plan and the Water Security Agency, visit http://www.wsask.ca.

First initiated by the Saskatchewan Watershed Authority in 2006, the WSA will continue to conduct State of the Watershed reporting on a regular basis to assess the health of watersheds in Saskatchewan. Saskatchewan's State of the Watershed reports (Saskatchewan Water Authority 2006, 2007, 2010) provide governments, decision-makers, industry and the community with scientifically defensible information needed to manage the province's water resources in an integrated manner.

A watershed, or drainage basin, is a region that drains into a specific body of water, such as a river or lake, and includes all the land, air, plants and animals within its boundary. Each watershed has its own unique mixture of land and water habitats, from wetlands, rivers, and lakes to forests, grasslands, farms and communities. Hills or other heights of land largely determine the boundaries of watersheds, as well as the speed and path of its streams and rivers. All watersheds within Saskatchewan ultimately drain into the Arctic Ocean, Hudson Bay or Gulf of Mexico. The province has 14 major watersheds ranging from the tiny Tazin River Watershed in the far northwest to the Souris River Basin in the southeast. For management and reporting purposes, the Saskatchewan Water Security Agency further divides these 14 major watersheds into 29 smaller watersheds (Figure 5.1).

Indicators for Water

Condition

5.1 Surface Water Quality – **Tracks the trend in Water Quality Index values for the watersheds of Saskatchewan.**

Stressor

5.2 Surface Water Quantity – **Tracks the amount of annual flow volume as a percentage of natural flow volume in a river or stream as an indicator of changes in flow regime and water quantity within a watershed.**

Response

5.3 Water Consumption and Conservation – **Tracks the changes in municipal water consumption in Saskatchewan's watersheds.**

Figure 5.1 Watersheds of Saskatchewan as Defined by Saskatchewan Water Security Agency

Source: Saskatchewan Watershed Authority 2010

5.1 Condition Indicator: Surface Water Quality

Why is this indicator important?

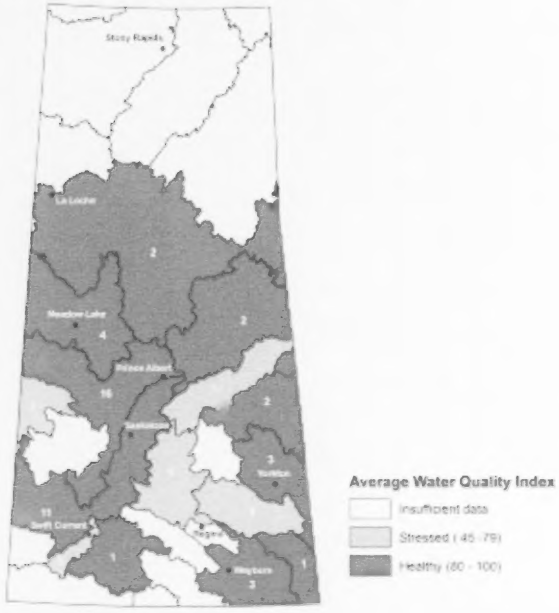
Good water quality is important for maintaining healthy ecosystems and human health. The intent of the surface water quality condition indicator, reported as a Water Quality Index (WQI), is to provide a standardized way of comparing and reporting water quality measurements in our rivers, streams, and lakes. The Water Quality Index was created in 1997 by the Canadian Council of Ministers of the Environment (Canadian Council of Ministers of the Environment 2001). The Index assesses the chemical, biological, and physical constituents of water at a given place and time. The Saskatchewan Water Security Agency collates the many measurements from a number of monitoring stations throughout the province and summarizes them as follows (Saskatchewan Water Authority 2010):

- Watersheds scoring between 80 and 100 are considered to be 'Healthy' (i.e. the watershed has no apparent change in function or services provided by water, and the system is both resistant and resilient to change);
- Watersheds scoring between 45 and 79 are considered to be 'Stressed' (i.e. the watershed has no degradation in function and/or services it provides); and
- Watersheds scoring less than 45 are considered to be 'Impacted' (i.e. the watershed has a change and/or degradation in function and/or services).

What does this indicator show?

Figure 5.2 shows the average Water Quality Index values for the watersheds of Saskatchewan from 2003 to 2007. Figure 5.3 shows the average Water Quality Index values for the watersheds of Saskatchewan from 2008 to 2012. Sufficient data existed for 16 watersheds (Figure 5.3) to report on their average surface water quality values (compared to 15 watersheds with sufficient data for the 2003 to 2007 time period). Of these 16 watersheds, eight (50 per cent) were judged to be Stressed (the Battle River, Carrot River, Lower Qu'Appelle River, Lower Souris River, Moose Jaw River, Old Wives Lake, Swift Current Creek, and Upper Qu'Appelle River Watersheds) and eight (50 per cent) were judged to be Healthy (Figure 5.3).

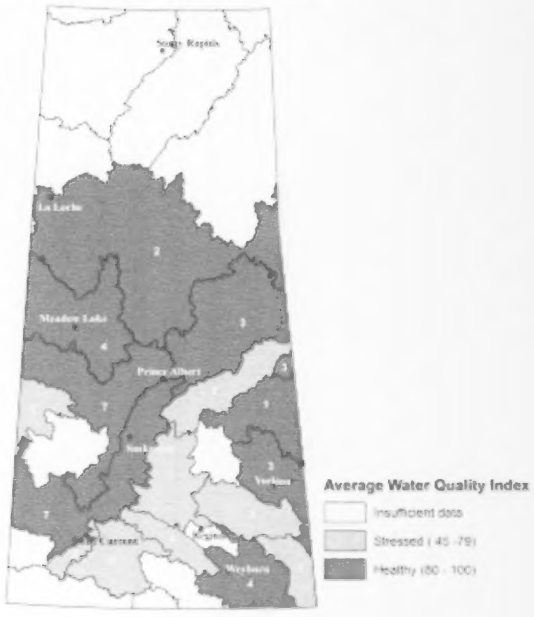
Figure 5.2 Average Water Quality Index Values by Watershed, 2003-2007



Note: The numbers within the watershed boundaries represent the number of monitoring stations used to calculate the averages.

Source: Saskatchewan Watershed Authority 2010

Figure 5.3 Average Water Quality Index Values by Watershed, 2008-2012



Source: Saskatchewan Water Security Agency 2013

The reduction in the WQI values in the eight watersheds is "mainly" the result of:

1. The reduction of the number of sampling sites

The differences in the five-year average Water Quality Index values between the time periods 2003-2007 and 2008-2012 (Figures 5.2 and 5.3) are due to the following:

- The total number of water quality sampling sites used to calculate the average Water Quality Index decreased by 15 sites. Between 2003-2007, seventy-one water quality sites were sampled (Figure 5.2), and between 2008-2012 56 water quality sampling sites were sampled (Figure 5.3). Only 40 of the original 71 sites were sampled in both time periods. The reduction in the number of water quality sampling sites is due to a number of factors, including:
    a. The Lake Stewardship Program ended in March of 2008. The elimination of this program resulted in the reduction of 23 water quality sampling sites (17 lakes) that were used to calculate the average WQI values between 2003-2007 (Figure 5.2)
    b. As of 2008, the Swift Current Creek Watershed Stewards stopped sampling seven of the eight water quality sampling sites they had previously sampled from 2004 and 2007
    c. The Swift Current Creek Watershed Stewards continues to monitor one water quality sampling site along the Swift Current Creek. However, the water data from this sample cannot be used to obtain a WQI value, as only three of the 16 water quality parameters in the Water Quality Index are collected at this site
    d. In 2008, Saskatchewan Ministry of Agriculture and the Water Security Agency (formerly known as the Saskatchewan Watershed Authority) initiated sampling of 16 sites along lower order streams in agricultural areas. The goal of the project was to assess annual variability and long-term changes in water quality associated with agricultural practices.
- The number of watersheds with Water Quality Index values increased from 15 watersheds in Figure 5.2 to 16 watersheds in Figure 5.3. The Moose Jaw River Watershed is the watershed that did not have an average Water Quality Index value in the earlier time period (Figure 5.2), but did in the later time period (Figure 5.3). Between 2003 and 2007 there were no water quality sites within the Moose Jaw River Watershed that could be used to calculate the Water Quality Index. However, since 2008, with the initiation of the Saskatchewan Ministry of Agriculture and the Water Security Agency 's project to assess the water quality of lower order streams in agricultural areas, two water quality sites within the Moose Jaw River Watershed have been sampled.

2. Change in sampling site location rather than a reduction in water quality at the same site

The water quality for both the Old Wives Lake and the Lower Souris River Watersheds declined between the two time periods 2003-2007 and 2008-2012. The reason for this change is that the average WQI values for the first time period (Figure 5.2) for both watersheds were collected from a lake with high water quality and then at a lower order stream site for the second time period (Figure 5.3). As previously mentioned, the change is sampling sites was due to the greater emphasis on assessing water quality of lower order streams in agricultural areas.

What actions are being taken?

A range of legislative tools, innovative strategies and policies assist in protecting and improving water quality in Saskatchewan, including:

- *The 25 Year Saskatchewan Water Security Plan* (Water Security Agency 2012)
- *The Water Regulations, 2002*, administered by the Water Security Agency and *The Environmental Management and Protection Act, 2010*, administered by the Saskatchewan Ministry of Environment. These acts also define the WSA's provincial authority for aquatic ecosystem protection and the broader aquatic habitat protection objectives
- *The Fisheries Act*, regulated by Fisheries and Oceans Canada
- The Interim Surface Water Quality Objectives as determined by the Saskatchewan Ministry of Environment

- Saskatchewan's Safe Drinking Water Strategy, Government of Saskatchewan 2002
- The Saskatchewan Environmental Code, a new regulatory tool that is part of the Ministry of Environment's new results-based regulatory reform initiative. The Saskatchewan Environmental Code was developed to help the Ministry achieve its vision of protecting the environment and promoting sustainable use of natural resources to enhance economic and social benefits (Saskatchewan Ministry of Environment 2011).

In addition to legislative tools, there are a number of federal and provincial government programs in the province that monitor the quality of surface and/or ground water for a variety of purposes. These monitoring programs include:

- The Saskatchewan Water Security Agency's Surface Water Monitoring Program
- The Prairie Provinces Water Board's Monitoring Program
- The Saskatchewan Ministry of Environment's Intensive Livestock Operations' Monitoring Program
- The Saskatchewan Ministry of Environment's Cumulative Effects Monitoring Program in northern Saskatchewan, and
- Environment Canada's Environmental Effects Monitoring Program.

5.2 Stressor Indicator: Surface Water Quantity

Why is this indicator important?

Surface water quantity is the amount of surface water within a watershed. From an environmental perspective, water quantity stressors relate to departures from the natural flow regime due to human use and development (Saskatchewan Water Authority 2007, 2010). In Saskatchewan, surface water is used for many purposes including human consumption, ecosystem health and economic activities such as industrial uses, power generation, and agriculture. Natural fluctuations in stream flows are important for conserving the biodiversity and health of ecosystems such as wetlands and riparian areas. Changes in flow regimes affect the aquatic ecology of these ecosystems and may result in alterations in aquatic habitat, aquatic communities, riparian zones, floodplains, wetlands, the stability of river channels, and water levels.

The amount of flow in a river or stream is affected by a number of factors including precipitation, soil infiltration rate, groundwater discharge, evapotranspiration, aquatic fragmentation, water regulation, water withdrawals, and water inputs from human sources such as irrigation, wastewater, and directed storm water runoff. The net available surface water in a watershed can be estimated by subtracting the sum of water allocations and downstream obligations from the estimated natural runoff volume. Other stressors to water supply in Saskatchewan include variability in short-term and long-term weather patterns, and increasing use and diversion in upstream jurisdictions (Saskatchewan Water Authority 2007, 2010).

What does this indicator show?

Figure 5.4 shows the Surface Water Quantity indicator values (average annual recorded flow volume as a percentage of natural flow volume within the last 30 years) for all watersheds in Saskatchewan (Saskatchewan Water Authority 2010). The indicator is categorized into three classes: Low Intensity; Moderate Intensity; and High Intensity. Low Intensity means 95 to 100 per cent of the water is available to the ecosystem; Moderate Intensity means 70 to 94 (or more than 100) per cent is available; and High Intensity means less than 70 per cent is available.

Seven of the 29 watersheds (24 per cent) are rated as High Intensity and nine (31 per cent) are Moderate Intensity; all are in the southern half of the province where the human population and demand for water are highest. The Lower Qu'Appelle River and the Upper Qu'Appelle Watersheds have recorded flow greater than 100 per cent of the natural flow due to the diversion of water from Lake Diefenbaker through the Qu'Appelle conveyance channel. The remaining watersheds (45 per cent) are all rated as Low Intensity.

Figure 5.4 Average Annual Recorded Flow Volume as a Percentage of Natural Flow Volume by Watershed, 2010

Source: Saskatchewan Water Security Agency 2013

What actions are being taken?

To ensure surface water allocation is sustainable at a watershed level, the Water Security Agency (under Authority from *The Saskatchewan Watershed Authority Act, 2005*) regulates:

- The construction, extension, alteration and operation of any works (e.g. dikes, dams, weirs, floodgates, breakwaters, reservoirs, canals, tunnels, bridges and culverts) in Saskatchewan
- Surface water allocation by issuing approvals to construct and operate works and water rights licenses, with the exception of domestic use.

The Water Security Agency is leading implementation of a number of actions from the *25 Year Saskatchewan Water Security Plan* including:

- Developing a modern system of water allocation, including a new allocation policy and regulations
- Reviewing existing water rights licences and assessing current water use
- At a watershed level, determining the existing use of water, level of protection of environmental flows and how much water is available for future allocation and identify areas where water scarcity may be a factor

- Implementing the Water Availability Study including:
  - Developing detailed aquifer maps
  - Analyzing the water supply situation in the major rivers
  - Determining existing water use by sector and delineation by the major basins
  - Examining projected water demand by sector within major basins to the year 2060
  - Identifying environmental flows to support the aquatic ecosystem.
- Assessing the infrastructure needs to supply water from Lake Diefenbaker to Buffalo Pound Lake to support existing and proposed developments in the Qu'Appelle River watershed
- Analyzing the economic value of water in alternative uses to help inform the development of a new water allocation policy that will establish priorities for water allocation and use
- Development of an electronic data storage and retrieval system to ensure the use of information and knowledge by not only the Water Security Agency but made readily available to anyone who has an interest in water availability or water protection
- Analysis of the most likely impacts of climate change on our future water supply

In Saskatchewan, surface water quantity is monitored cooperatively by the federal and provincial governments through the national hydrometric program. The activities of this program include the collection, interpretation, and dissemination of surface water quantity data and information to decision makers and the public. Access to surface water quantity data gathered through this program can be found online at:

- The Water Survey of Canada Website, an Environment Canada initiative (http://www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1)
- The Saskatchewan Water Security Agency's Provincial Streamflow Forecast Webpage (https://www.wsask.ca/en/Lakes-and-Rivers/Stream-Flows-and-Lake-Levels/)

5.3 Response Indicator: Water Consumption and Conservation

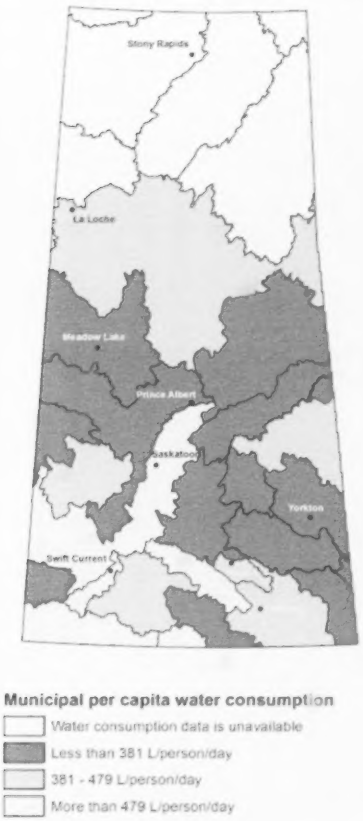
Why is this indicator important?

Despite the abundance of water in Saskatchewan, most of it is in the northern half of the province, and much of the water in the south is directed for human use. Combine this situation with the semi-arid climate of the prairies means that the conservation of water should be a high priority. In addition, pumping and treating water consumes energy, so reducing water use reduces energy consumption and greenhouse gas emissions.

What does this indicator show?

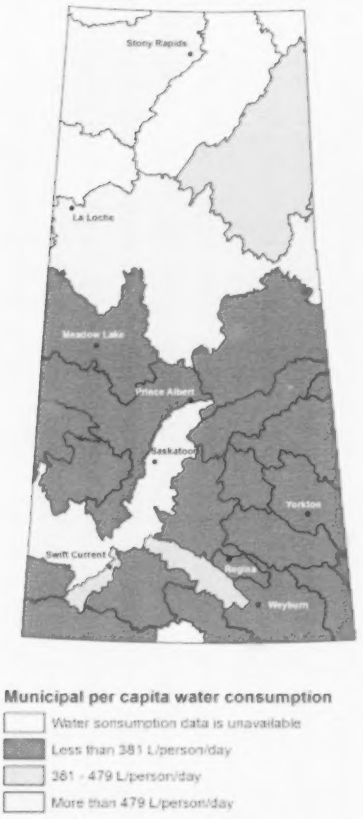
Figures 5.5 and 5.6 show the daily per capital municipal water consumption in Saskatchewan's watersheds in 2007 and 2011 respectively. (Pers. Comm. Andrew Thornton, Water Security Agency, 2013). Municipal water use includes water used mainly for residential, industrial, and commercial uses. For 2007, municipal per capita water consumption was rated as less than 381 litres/person/day for 12 watersheds, between 381 and 479 litres/person/day for seven watersheds, and more than 479 litres/person/day for five watersheds (Figure 5.5). For 2011, municipal per capita water consumption is rated as less than 381 litres/person/day for 18 watersheds, between 381 and 479 litres/person/day for three watersheds, and more than 479 litres/person/day for three watersheds (Figure 5.6).

Figure 5.5 Estimate of Per Capita Daily Municipal Water Consumption by Watershed, 2007



Source: Saskatchewan Watershed Authority 2010

Figure 5.6 Estimate of Per Capita Daily Municipal Water Consumption by Watershed, 2011



Source: Saskatchewan Water Security Agency 2013

Trends in the Water Consumption and Conservation Indicator between 2007 and 2011 (Figures 5.5 and 5.6) include:

- On average, across the 22 watersheds that had water consumption data for both 2007 and 2011, water consumption decreased by 17 per cent between 2007 and 2011.
- Eight of the twenty-two watersheds, for which water consumption data is available for both 2007 and 2011, had a decrease in per capita water consumption between 2007 and 2011 and moved from a higher water consumption rating in 2007 to a lower water consumption rating in 2011.
- The Churchill River Watershed was the only watershed that increased their water consumption such that they moved from a lower water consumption rating in 2007 to a higher water consumption rating in 2011.

Reasons for the decrease in water use may include, increased water conservation (including the use of: low flow toilets, showerheads and faucets; and more water efficient appliances, such as washers and dishwashers), repaired leaks and improvements in how water use is recorded and less water used for outdoor landscape watering. The Churchill River Watershed was the only watershed that had an increase in per capita water consumption between 2007 and 2011. Reasons for the increase in water use in this watershed may include a new industrial user (as municipal use includes both domestic and some industries) or an increase in leaks. However, to fully understand these increases or decreases individual studies on these watersheds would be required.

What actions are being taken?

A detailed description of various water conservation programs and measures in use in Saskatchewan can be found in the most recent 2010 State of the Watershed Report (Saskatchewan Watershed Authority 2010). The following are some selected examples:

Providing educational information on water conservation to the public

A joint effort between the former Saskatchewan Watershed Authority, Ministry of Agriculture and watershed stewardship groups produced the booklet *Water Efficiency on the Farm*. The booklet provides best water use practices for managing livestock, irrigation and the farmyard. It is available in hard copy and online (Saskatchewan Watershed Authority 2011).

The booklet entitled *Water Use in Your Home: What you need to know to use less and spend less* (2009) provides information on how homeowners can conduct an in-home water audit and ways of reducing indoor and outdoor water use. It is available in hard copy and online (Saskatchewan Environmental Society 2009).

Promoting the purchase and use of water efficient fixtures

In January 2009, the Government of Saskatchewan initiated the Provincial Toilet Replacement Rebate Program. This program, which was funded through the Go Green Fund and administered by the Saskatchewan Water Security Agency, provided a rebate of $50 for the purchase of a toilet that uses six litres or less per flush (including dual flush models) when it replaced a higher volume toilet in single family dwellings and multiple-unit complexes (up to a maximum of three toilets per home or unit). The program ended December 2012. As of December 31, 2012, over 60,000 toilets had been replaced with total savings of 3.9 billion litres of water and reduction in CO_2 emissions of 11,700 tonnes (Pers. Comm. Dolores Funk, Water Security Agency, 2013). In comparison, in February 2011, 30,364 toilets were replaced with total savings of 1 billion litres of water and reduction in CO_2 emissions of 3,231 tonnes.

Universal metering

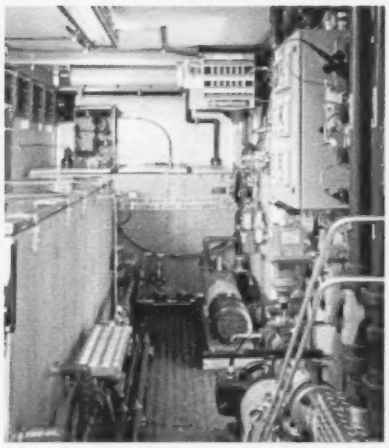
Used with a volume-based pricing structure, water metering is a good water conservation practice, as it provides a measure of consumers' actual water use. According to the 2009 Municipal Water Use Survey, of the Saskatchewan municipalities that responded to the survey, 98.2 per cent of residential clients and 98.9 per cent of business clients served by municipal water systems were metered. According to the survey, the Province of Saskatchewan had the highest percentage of metered residential clients in the country (Environment Canada 2011).

Other water conservation activities the Water Security Agency is involved in include:

- establishing water conservation partnerships; developing, in conjunction with industry associations, industry recommended practices; and
- promoting and education of the WaterSense label for water efficient appliances. The WaterSense label is a registered mark that identifies certified water-efficient products available to Saskatchewan consumers that offer them a simple way to use less water. Products with the WaterSense label are certified to be at least 20 per cent more water efficient than average products and to perform as well or better that their less efficient counterparts.

Educating and Engaging our Future Stewards

Project WET is an interactive educational program about water resources and stewardship for K to 12 students. The program is delivered in Saskatchewan through the Saskatchewan Outdoor Environmental Education Association (SOEEA) in partnership with the Canadian Water Resources Association – Saskatchewan Branch (CWRA-SK). Project WET is complementary to Project WILD and covers such topics as water chemistry, water quality and human health, climate and weather, water conservation, cultural values about water, and how to launch action programs and create water festivals/celebrations. Educators receive a Project WET Activity Guide, with 91 complete lesson plans and mini-units, through a one day Project WET professional development workshop delivered by SOEEA.



ElectroPure: A new technology to treat industrial wastewater

Fresh water is used by industry, in many instances, where the water is not required to be potable. ElectroPure Technology (EPT), developed by Ground Effects Environmental Services Inc., is designed to limit the use of fresh water by industry through the treatment and reuse of existing industrial waste water. EPT is a newly developed water treatment system that has the ability to efficiently remove a wide range of contaminants from wastewater simultaneously through a chemical free process using electrochemistry. With the capacity to run 24 hours a day, the EPT system could treat up to 198 million litres of water a year. The EPT system is designed to work as a permanent or temporary installation making it very adaptable to a wide variety of industrial applications. A pilot project, partially funded by the Go Green Fund, demonstrated numerous environmental contaminants were reduced through application of the technology and total water treated was 1.27 million litres over a 21-day period based on a 75,000 litres per day average treatment rate.

Local Watershed Stewardship

Various watershed stewardship groups, made up of local residents, producers, land managers, industry and municipalities, have been established throughout Saskatchewan to lead the implementation and monitoring of watershed and aquifer source water protection plans. These plans are the result of the Water Security Agency's Watershed and Aquifer Planning program, initiated in 2002, to develop source water protection plans that identify and integrate existing land use interests. The umbrella organization, the Saskatchewan Association of Watersheds, works with the watershed stewardship groups on common watershed issues at the provincial level. The groups include: the Assiniboine Watershed Stewardship Association, the Lower Souris Watershed Committee Inc., the Moose Jaw River Watershed Stewards, the North Saskatchewan River Basin Council, the South Saskatchewan River Watershed Stewards Inc., the Swift Current Creek Watershed Stewards, the Upper Souris Watershed Association the Wascana Upper Qu'Appelle Watersheds Association Taking Responsibility, Inc. and the most recently incorporated Carrot River Valley Watershed Association (October 2011). The watershed and aquifer planning process has been initiated in the Lower Qu'Appelle River and Old Wives Lake Watersheds.

Highlights for Water

Southern Saskatchewan has high demands on its limited water resources, as reflected by the status of the key water indicators selected in this report and those reported on in the 2010 State of the Watershed Report (Saskatchewan Watershed Authority 2010).

The following is a summary of the status and trend of the three water indicators reported on in this chapter:

5.1 **Surface Water Quality** - Since 2007, the average Water Quality Index has remained consistent at individual water quality sampling sites. Changes in the average Water Quality Index for two watersheds between 2003-2007 and 2008-2012 is not a reflection of changes in water quality, but rather changes in the location of water quality sampling sites.

5.2 **Surface Water Quantity** - Alteration of natural flow regimes continues to be a stressor on a number of watersheds in southern Saskatchewan.

5.3 **Water Consumption and Conservation** - On average, across the 22 watersheds that had water consumption data for both 2007 and 2011, water consumption decreased during that period.

With a growing economy and population, demands on Saskatchewan's water resources are likely to increase in the future. To prepare for and to manage the increasing pressures on Saskatchewan's watersheds and in recognition of the need for a long-term water management plan, the *25 Year Saskatchewan Water Security Plan* was developed and finalized in the fall of 2012. The Plan is a forward-looking document that provides guidance for all of the province's work around water.

Setting the Stage for Future State of the Environment Reporting

The reporting framework, themes and indicators outlined in this report were established in Saskatchewan's *2011 State of the Environment Report* and provided the foundation to prepare the *2013 State of the Environment Report*. The *2013 SoE* continues the trend of improvement and refinement as shown over the past 11 iterations of the report. State of the environment reporting will continue to evolve in response to changing environmental priorities and public concerns, and a drive for continuous improvement in reporting. Key considerations for future state of the environment reporting in this province are the Ministry's continuing transition towards a results-based regulatory system, including the development of the Saskatchewan Environmental Code, and current and future Ministry initiatives that lead to the best possible outcomes for both the environment and the people of Saskatchewan.

Results-based Regulations

Saskatchewan is adopting a new, less prescriptive legal framework for managing and protecting the environment as a way to address the demands of a growing economy and to foster innovative solutions by industry for enhanced environmental protection (Saskatchewan Ministry of Environment 2009, 2013a). Saskatchewan's current regulatory regime, developed in the 1970s to address industrial point source pollution and non-renewable resource harvesting, relies heavily on permits regardless of the risk to the environment. The advancement of science and technology together with the growth of our economy prompted the Ministry to reassess its environmental regulatory framework. Results-based regulation (RBR) represents a significant shift away from highly prescriptive legislation and regulations to a focus on holding proponents accountable for achieving desired environmental outcomes. RBR also provides core requirements and expected results for increased transparency in information and all processes, incentives for industry and businesses to improve their environmental management and allow for continuous improvement and updates to keep pace with changing economic and environmental priorities.

To support a results-based approach, several key pieces of enabling legislation were modernized. Introduced in the fall 2009 legislative session and passed by the legislature in spring 2010, these include *The Environmental Assessment Act, The Forest Resources Management Act, The Environmental Management and Protection Act, 2010* and *The Management and Reduction of Greenhouse Gases Act*. *The Environmental Assessment Act* was proclaimed in November 2012. The new or amended versions of the remaining acts have been passed but have not been proclaimed, so they do not yet have the force of law. The initial sections of the Saskatchewan Environmental Code are nearing completion and will result in the new legislative framework to be brought into effect in the spring of 2013.

The Saskatchewan Environmental Code

One of the key features of the new results-based regulatory system is the Saskatchewan Environmental Code. The code is a clear, concise statement of objectives, recommended practices and alternatives that will govern the management and protection of Saskatchewan's environment and natural resources while promoting economic growth (Saskatchewan Ministry of Environment 2013b).

A Code Development Committee was established in the summer of 2010 as a formal forum to develop the code by consensus. It provides advice and guidance to the Minister on the content of the code and its supporting materials. Made

up stakeholder representatives from industry, environmental organizations and communities; their role is to provide the opportunity to contribute directly to the development of the code. An extensive consultation process has also occurred with a number of experts, stakeholders and interested parties to discuss and provide input to the results-based approach, the related legislation and the code.

In essence, the Saskatchewan Environmental Code defines the required environmental outcomes and largely leaves how to achieve compliance up to the regulated community. The code's wide scope covers resource management as well as environmental management and protection activities governed by the Acts that reference the code. The code addresses a wide range of areas including climate change, forest management, drinking water distribution, impacted sites and landfills. The code provides the regulated community options on how to achieve the expected results. Proponents may follow the "acceptable solutions" (a predefined process) or propose their own "alternative solutions" signed off by a qualified person and accepted by the Minister.

Given the Ministry's transition towards RBR and the code, it makes sense for future state of the environment reporting to become more aligned with the new legal framework and its focus on outcomes.

Boreal Watershed Management Strategy

Another consideration for future reporting is the emergence of provincial and regional-scale priorities that require attention and a strategic response. One such example is the initiation of the Boreal Watershed Management Strategy.

Canada's boreal forest, including northern Saskatchewan, contains some of the largest and highest-quality freshwater resources on earth. The quality of these resources is largely dependent upon the ecological integrity of the watersheds in which they reside.

The Boreal Watershed Management Strategy was established in 2011 to assess the ecological integrity of Saskatchewan's northern watersheds. The Ministry of Environment has been collaborating with partners to address potential environmental concerns and to identify sustainable management practices in the region. Significant amounts of historical information have been gathered and reviewed to help identify potential knowledge gaps.

The monitoring program has been broken into seven priority areas: water quality, aquatic ecosystem health, air quality, soil quality, terrestrial ecosystem health, terrestrial biodiversity and traditional knowledge. The first two years of the project have focused on gathering information in strategic or sensitive areas, and the development of tools that show promise in long-term monitoring of this vast landscape. Year five of the strategy will result in a comprehensive report for the Boreal Region that identifies environmental safeguards and thresholds for safe stewardship of the land's resources.

The program has brought together a wide range of partnerships including the Federal Government, the province of Alberta, universities, colleges, school divisions, northern communities, and non-government organizations. The Boreal Watershed Management Strategy will allow the Ministry and key stakeholders, such as industry and northern residents, to evaluate current conditions, better protect the environment and facilitate the sustainable growth of the north.

Where to from here?

The current report builds on over 20 years of experience in reporting on the health of the environment in Saskatchewan. As the Ministry moves forward on the path of results-based regulatory reform, improving public access to environmental information is essential to gain a better understanding of the environment, and its condition, and enable effective action for management and protection. To work towards this result, the Ministry is exploring on-line state of the environment reporting for continuous updating to provide the most current scientific data and information available.

References

State of Environment Reporting in Saskatchewan

Saskatchewan Environment. 2003. *Saskatchewan's 2003 State of the Environment Report: A Provincial Perspective*. Regina, SK: Saskatchewan Environment.

Saskatchewan Environment. 2005. *Saskatchewan State of the Environment Report 2005*. Regina, SK: Saskatchewan Environment. Retrieved from http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=547,543,94,88,Documents&MediaID=222&Filename=State+of+the+Environment+Report.pdf.

Saskatchewan Environment and Public Safety. 1991. *Saskatchewan State of the Environment Report*. Regina, SK: Saskatchewan Environment and Public Safety.

Saskatchewan Environment and Resource Management. 1993. *Saskatchewan's State of the Environment Report – The Need for Environmental Indicators 1992*. Regina, SK: Saskatchewan Environment and Resource Management.

Saskatchewan Environment and Resource Management. 1995. *Saskatchewan's State of the Environment Report 1995 – The Boreal Plain Ecozone: A Forest Community*. Regina, SK: Saskatchewan Environment and Resource Management.

Saskatchewan Environment and Resource Management. 1997. *Saskatchewan's State of the Environment Report 1997 – The Prairie Ecozone: Our Agricultural Heartland*. Regina, SK: Saskatchewan Environment and Resource Management.

Saskatchewan Environment and Resource Management. 1999. *Saskatchewan's State of the Environment Report 1999 – The Boreal Shield Ecozone: A Land of Lakes and Forests*. Regina, SK: Saskatchewan Environment and Resource Management.

Saskatchewan Environment and Resource Management. 2001. *Saskatchewan's State of the Environment Report 2001 – Taiga Shield Ecozone: Land of the Caribou*. Regina, SK: Saskatchewan Environment and Resource Management.

Saskatchewan Ministry of Environment. 2009. *Saskatchewan's 2009 State of the Environment – State of Saskatchewan's Provincial Forests*. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from http://www.environment.gov.sk.ca/soereport.

Saskatchewan Ministry of Environment. 2011. *Saskatchewan's 2011 State of the Environment Report*. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from http://www.environment.gov.sk.ca/soereport2011.

Saskatchewan Ministry of Environment. 2012. Ministry Overview. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from http://www.environment.gov.sk.ca/ministry-overview/.

Saskatchewan Watershed Authority. *2007 State of the Watershed Report*. Regina, SK: Saskatchewan Watershed Authority. Retrieved from http://www.publications.gov.sk.ca/details.cfm?p=23058.

Saskatchewan Watershed Authority. 2010. *2010 State of the Watershed Report*. Regina, SK: Saskatchewan Watershed Authority. Retrieved from https://www.wsask.ca/About-WSA/Publications/State-of-the-Watershed-Report---2010/.

Water Security Agency. 2012. Annual Reports/Performance Plans. Regina, SK: Water Security Agency. Retrieved from https://www.wsask.ca/About-WSA/Annual-Reports/.

Air

CCME. 2006. *Particulate Matter and Ground-level Ozone – Canadian-wide Standards for Particulate Matter (PM) and Ozone*. Ottawa, ON: Canadian Council of Ministers of the Environment. Retrieved from http://www.ccme.ca/ourwork/air.html?category_id=99.

Environment Canada 2011. *An Integrated Oil Sands Environmental Monitoring Plan*. Ottawa, ON: Environment Canada. Retrieved from http://www.ec.gc.ca/pollution/EACB8951-1ED0-4CBB-A6C9-84EE3467B211/Integrated%20Oil%20Sands_low_e.pdf.

Environment Canada 2012. National Pollution Release Inventory. Ottawa, ON: Environment Canada. Retrieved from http://www.ec.gc.ca/inrp-npri/.

Environment Canada. 2013. Pollutants. Ottawa, ON: Environment Canada. Retrieved from http://ec.gc.ca/Air/.

Jeffries, D.S. R.G. Semkin, J.J. Gibson, and I. Wong. (2010). "Recently surveyed lakes in northern Manitoba and Saskatchewan, Canada: characteristics and critical loads of acidity." J. Limnol. 69(Suppl. 1): 45-55.

Policy Horizons Canada 2011. *The Evaluation of Place-Based Approaches: Questions for Further Research*. Retrieved from http://www.horizons.gc.ca/doclib/2011_0074_EvaluationPB_e.pdf.

Saskatchewan Ministry of Environment. 2009. *Results-Based Regulatory Model – A Review of The Environmental Management and Protection Act, 2002*: [proposed amendments to The Environmental Management and Protection Act, 2002]. Regina, SK: Saskatchewan Ministry of Environment.

Saskatchewan Ministry of Environment. 2011. *Saskatchewan's 2011 State of the Environment Report*. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from http://www.environment.gov.sk.ca/soereport2011.

Scott, K. A., B. Wissel, J.J. Gibson, and S.J. Birks (2010). "Chemical characteristics and acid sensitivity of boreal headwater lakes in northwest Saskatchewan." *J. Limnol*. 69(Suppl. 1): 33-44.

Climate

Barrow, E. 2009. *Climate Scenarios for Saskatchewan*. Prairie Adaptation Research Collaborative (PARC). Regina, SK: University of Regina. Retrieved from http://www.parc.ca/pdf/research_publications/renamed/PP2009-01_web.pdf.

Environment Canada. 2004. *Canada's greenhouse gas inventory 1990-2002: Greenhouse gas emission summary, 1990-2002*. Ottawa, ON: Environment Canada. Retrieved from http://www.ec.gc.ca/Publications/0092441D-EDA1-4F76-BDFA-3A53C75F3E11%5CCanadasGreenhouseGasInventoryOverview19902002.pdf.

Environment Canada. 2012. *National Inventory Report 1990-2010*. Greenhouse Gas Sources and Sinks in Canada. Ottawa, ON: Environment Canada

Saskatchewan Bureau of Statistics. 2012. Economic Accounts. Regina, SK: Bureau of Statistics. Retrieved from http://www.stats.gov.sk.ca/Default.aspx?DN=6dab2e58-1fdc-4ab2-aab4-f0671ddbeae9.

Sauchyn, D., Barrow, E., Fang, X., Henderson, N., Johnston, M., Pomeroy, J., Thorpe, J., Wheaton, E., and Williams, B. 2009. *Saskatchewan's Natural Capital in a Changing Climate: An Assessment of Impacts and Adaptation, Summary Document*. Prairie Adaptation Research Collaborative (PARC), Regina, SK: University of Regina. Retrieved from http://www.parc.ca/pdf/research_publications/summary_docs/SD2009-02.pdf.

World Resources Institute. 2005. *WRI's Annual Carbon Dioxide Inventory Report (2005)*. Washington DC: World Resources Institute (WRI).

Land

CCPCCP. 2011. *CropLife Canada Pesticide Container Collection Program*. Fact sheet. Retrieved from http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=1680,251,94,88,Documents&MediaID=1333&Filename=Pesticide+Container+Collection+Program.pdf&l=English.

CleanFARMS 2013. CleanFarms Inc. Further information from http://www.cleanfarms.ca/.

Eilers, W., R. MacKay, L. Graham and A. Lefebvre (Eds). 2010. *Environmental Sustainability of Canadian Agriculture: Agri-Environmental Indicator Report Series – Report #3*. Ottawa, ON: Agriculture and Agri-Food Canada. Retrieved from http://www4.agr.gc.ca/resources/prod/doc/prog/pdf/asca-aedc_rep2010_eng.pdf.

Hofmann, N. 2008. *Conventional tillage: How conventional is it?* Ottawa, ON: Statistics Canada. Retrieved from http://www.statcan.gc.ca/pub/16-002-x/2008003/article/10688-eng.htm.

PCAP. 2010. *Saskatchewan Prairie Conservation Action Plan – Framework 2009-2013*. Regina, SK: Prairie Conservation Action Plan. Retrieved from http://www.pcap-sk.org/docs/PCAP_2009-2013_Framework.pdf.

Product Care 2013. Saskatchewan Paint Recycling Program. Further information from http://www.productcare.org/Saskatchewan.

Prospectors and Developers Association of Canada. 2013. Environmental Excellence in Exploration initiative. Toronto, ON: Prospectors and Developers Association of Canada, Retrieved from http://www.pdac.ca/.

Recycle Saskatchewan. 2013. Saskatchewan Waste Reduction Council. Saskatoon, SK: Recycle Saskatchewan. Further information from http://www.recyclesaskatchewan.ca/index.html.

SARCAN Recycling. 2013. Saskatchewan Association of Rehabilitation Centres. Saskatoon, SK. Further information from http://www.sarcsarcan.ca/sarcan/index.php.

SARRC. 2013. Saskatchewan Association for Resource Recovery Corporation. Saskatoon, SK. Further information from http://www.usedoilrecycling.com/en/sk.

Saskatchewan Mining Association. 2012. General Information. Regina, SK. http://www.saskmining.ca/uploads/general_files/24/sma-fact-sheets-2012.pdf.

Saskatchewan Ministry of Agriculture. 2011. Personal communication: Ken Panchuk. Production Technology Unit. Regina, SK: Crops Branch, Saskatchewan Ministry of Agriculture.

Saskatchewan Ministry of Agriculture. 2012. Agricultural Statistics. Regina, SK: Saskatchewan Ministry of Agriculture. Retrieved from http://www.agriculture.gov.sk.ca/agriculture_statistics/.

Saskatchewan Ministry of Environment. 2008. *Saskatchewan Paint Stewardship Program*. Fact sheet. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=1684,251,94,88,Documents&MediaID=1336&Filename=The+Saskatchewan+Paint+Recycling+Program.pdf&l=English.

Saskatchewan Ministry of Environment 2010. Annual Report 2009-2010. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from http://www.environment.gov.sk.ca/annual-report/.

Saskatchewan Ministry of Environment. 2011. *Saskatchewan's 2011 State of the Environment Report*. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from http://www.environment.gov.sk.ca/soereport2011.

Saskatchewan Ministry of Environment. 2013a. Lands Branch. Regina, SK: Saskatchewan Ministry of Environment.

Saskatchewan Ministry of Environment. 2013b. Recycling. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from: http://www.environment.gov.sk.ca/Default.aspx?DN=22fb9d52-7265-42aa-973d-3274ab62da25.

Saskatchewan Ministry of the Economy. 2012. Mineral Disposition Activity in Saskatchewan. Regina, SK: Saskatchewan Ministry of the Economy.

Saskatchewan Ministry of the Economy. 2013. Land Tenure – Statistics. Regina, SK: Saskatchewan Ministry of Energy and Resources. Retrieved from http://www.er.gov.sk.ca/Default.aspx?DN=3698,3402,3384,2936,Documents.

Saskatchewan Waste Reduction Council. 2013. Saskatoon, SK. Further information from http://www.saskwastereduction.ca/.

Saskatchewan Watershed Authority. 2010. *2010 State of the Watershed Report*. Regina, SK: Saskatchewan Watershed Authority. https://www.wsask.ca/About-WSA/Publications/State-of-the-Watershed-Report---2010/.

SSCA. 2013. Saskatchewan Soil Conservation Association. Indian Head, SK. Further information from http://www.ssca.ca/.

SSTC. 2013. Saskatchewan Scrap Tire Corporation. Regina, SK. Further information from http://www.scraptire.sk.ca/.

Statistics Canada. 2011a. Land use. Farm and farm operator data. 2011 Census of Agriculture. Ottawa, ON: Statistics Canada. Retrieved from http://www29.statcan.gc.ca/ceag-web/eng/community-agriculture-profile-profil-agricole?geoId=4700000008selectedVarIds=79%2C78%2C77%2C73%2C74%2C75%2C76%2C.

Statistics Canada. 2011b. Tillage practices used to prepare land for seeding. Farm and farm operator data. 2011 Census of Agriculture - Saskatchewan. Ottawa, ON: Statistics Canada. Retrieved from http://www29.statcan.gc.ca/ceag-web/eng/community-agriculture-profile-profil-agricole?geoId=4700000008selectedVarIds=90%2C87%2C88%2C89%2C.

SWEEP 2013. Saskatchewan Waste Electronic Equipment Program. Regina, SK. Further information from http://www.sweepit.ca.

Water Security Agency 2013. Conservation Agreements by Watershed. Personal Communication. Andrew Thorton. Regina, SK: Water Security Agency.

West, T.O. and W.M. Post. 2002. *Soil Organic Carbon Sequestration by Tillage and Crop Rotation: A Global Data Analysis*. Carbon Dioxide Information Analysis Center. U.S. Department of Energy. Oak Ridge, Tennessee, U.S.A: Oak Ridge National Laboratory. Retrieved from http://cdiac.ornl.gov/programs/CSEQ/terrestrial/westpost2002/westpost2002datatable.pdf.

Wicklum, D. and B. Gray. 2010. *Impact of Conservation Tillage on Landscape and Ecological Services: Challenges and Opportunities*. In: Lindwall, W. and B. Sonntag (Eds.). Landscapes Transformed: The History of Conservation Tillage and Direct Seeding. Knowledge Impact in Society, Saskatoon: University of Saskatchewan (pages 199-205). Retrieved from http://www.kis.usask.ca/ZeroTill/LandscapesTransformed_HistoryofCT_Book.pdf.

Wittrup, M.B and K.M. Murphy. 2012. The future of environmental regulation: Saskatchewan's move to results-based regulation. Uranium issue. CIM Journal Volume 3(2). Canadian Institute of Mining, Metallurgy and Petroleum.

Forest

BC Ministry of Forests 2013. *A History of the Battle against Mountain Pine Beetle, 2000-2012*. Victoria: BC: British Columbia Ministry of Forests. Retrieved from http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/Pine%20Beetle%20Response%20Brief%20History%20May%2023%202012.pdf.

PARC. 2010. Research summary documents. Regina, SK: Prairie Adaptation Research Collaborative. Retrieved from http://www.parc.ca/research_summaries.htm.

Logan, J. A., and J. A. Powell. 2004. Ecological consequences of climate change altered forest insect disturbance regimes. In F. H. Wagner (Ed.), *Climate change in western North America: evidence and environmental effects*. Lawrence, Kansas, U.S.A.: Allen Press. Retrieved from http://www.usu.edu/beetle/documents/Logan-Powell2005.pdf.

Saskatchewan Ministry of Environment. 2009. *Saskatchewan's 2009 State of the Environment – State of Saskatchewan's Provincial Forests*. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from http://www.environment.gov.sk.ca/soereport.

Saskatchewan Ministry of Environment. 2010. *Wildfire Management Strategies*. Regina, SK: Saskatchewan Ministry of Environment. http://www.environment.gov.sk.ca/Default.aspx?DN=cb0c0d80-a67a-4142-93ad-a824c4e361b2.

Saskatchewan Ministry of Environment. 2012a. *Forest Fire Management Strategy Zones in Saskatchewan - 2012*. Prepared by Fire Management and Forest Protection Branch. Prince Albert, SK: Saskatchewan Ministry of Environment.

Saskatchewan Ministry of Environment. 2012b. *Forest Fire History 1945-2012*. Prepared by Fire Management and Forest Protection Branch. Prince Albert, SK: Saskatchewan Ministry of Environment.

Saskatchewan Ministry of Environment. 2012c. *2012 Report on Saskatchewan's Forests*. Regina, SK: Saskatchewan Ministry of Environment.

Saskatchewan Ministry of Environment. 2013. Latest available information/data as of March 2013. Regina, SK: Saskatchewan Ministry of Environment.

Water

Canadian Council of Ministers of the Environment. 2001. "Canadian Water Quality Guidelines for the Protection of Aquatic Life: CCME Water Quality Index 1.0", Technical Report, in *Canadian Environmental Quality Guidelines*, 1999, Winnipeg.

Environment Canada. 2011. 2011 Municipal Water Use Report: Municipal Water Use 2009 Statistics. Ottawa, ON: Environment Canada. Retrieved from http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=ADD1975E-1.

Saskatchewan Environmental Society. 2009. *Water Use in Your Home: What you need to know to use less and spend less*. Retrieved from http://www.environmentalsociety.ca/main/wp-content/uploads/2012/08/Conservation_booklet_web.pdf.

Saskatchewan Ministry of Environment. 2011. Draft Saskatchewan Environmental Code: Moving forward in partnership. 10 pp.

Saskatchewan Watershed Authority. 2006. *State of the Watershed Reporting Framework*. Regina ,SK: Saskatchewan Watershed Authority.

Saskatchewan Watershed Authority. 2007. *State of the Watershed Report 2010*. Regina, SK: Saskatchewan Watershed Authority. Retrieved from http://www.publications.gov.sk.ca/details.cfm?p=23058.

Saskatchewan Watershed Authority. 2010. *State of the Watershed Report*. Regina, SK: Saskatchewan Watershed Authority . Retrieved from https://www.wsask.ca/en/About-WSA/Publications/State-of-the-Watershed-Report---2010/ .

Saskatchewan Watershed Authority. 2011. *Water Efficiency on the Farm*. Retrieved from https://www.wsask.ca/Global/Water%20Programs/Water%20Conservation/SWA-Water_Efficiency_on_the_Farm_Booklet_WEB.pdf.

Water Security Agency, 2012. *25 Year Saskatchewan Water Security Plan*. Regina, SK: Water Security Agency. 52 pp. Retrieved from https://www.wsask.ca/About-WSA/25-Year-Water-Security-Plan/.

Water Security Agency 2013.Latest available information/data as of March 2013. Regina, SK: Water Security Agency.

Moving Forward

Saskatchewan Ministry of Environment. 2009. *Toward a Results-Based Regulatory System*. Regina, SK: Clifton Associates Ltd. Retrieved from http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=06c78dfc-cbce-4a32-b16d-47a1a052dfd3&MediaID=1584&Filename=Report+and+Recommendations+February+2009.pdf&l=English.

Saskatchewan Ministry of Environment. 2013a. Results-Based Regulations. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from http://www.environment.gov.sk.ca/Regulations.

Saskatchewan Ministry of Environment. 2013b. Saskatchewan Environmental Code. Regina, SK: Saskatchewan Ministry of Environment. Retrieved from http://www.environment.gov.sk.ca/Default.aspx?DN=90730c83-5bda-4d33-9b25-bcde57eef1e8.

List of Acronyms

AQI	Air Quality Index
AQMS	Air Quality Management System
CACs	criteria air contaminants
CCME	Canadian Council of Ministers of the Environment
CCPCCP	CropLife Canada's Pesticide Container Collection Program
CWS	Canada-wide Standard
e3	Environmental Excellence in Exploration
FMA	Forest Management Agreement
GDP	gross domestic product
GHG	greenhouse gas
HVS	Harvest Volume Schedule
MMRP	multi-material recycling program
NCC	Nature Conservancy of Canada
NFI	National Forest Inventory
NPRI	National Pollutant Release Inventory
NPSS	Native Plant Society of Saskatchewan
NSR	not sufficiently regenerated
PARC	Prairie Adaptation Research Collaborative
PCAP	Prairie Conservation Action Plan
PM	particulate matter
PTRC	Petroleum Technology Research Centre
RAN	Representative Areas Network
SAML	Saskatchewan Air Monitoring Laboratory
SARRC	Saskatchewan Association for Resource Recovery Corporation
SASC	Saskatchewan Agricultural Stewardship Council
SESAA	Southeast Saskatchewan Airshed Association
SFA	Saskatchewan Forestry Association
SFVI	Saskatchewan Forest Vegetation Inventory
SOEEA	Saskatchewan Outdoor Environmental Education Association
SR	sufficiently regenerated
SRC	Saskatchewan Research Council
SSCA	Saskatchewan Soil Conservation Association
SSTC	Saskatchewan Scrap Tire Corporation
SWA	Saskatchewan Watershed Authority
SWEEP	Saskatchewan Waste Electronic Equipment Program
SWF	Saskatchewan Wildlife Federation
TSL	Term Supply Licence
VOCs	volatile organic compounds
WYAMZ	Western Yellowhead Air Management Zone
WSA	Water Security Agency
WQI	Water Quality Index

Glossary

acid deposition - the process by which acids are deposited, either by wet deposition in the form of rain, snow, sleet, hail or fog or as dry deposition in the form of particulates such as fly ash, sulphates, nitrates, or as gases like sulphur dioxide (SO2) and nitrogen oxides (NOx).

Agro-ecosystem - species and ecosystems under agricultural management; an open, dynamic system connected to other ecosystems through the flow of energy and the transfer of material such as crops, pastures, livestock, other flora and fauna, air, soil and water.

Air Quality Index - is an indicator of air quality, based on air pollutants that have adverse effects on human health and the environment. The pollutants are sulphur dioxide (SO2), nitrogen dioxide (NO2), ozone (O3), carbon monoxide (CO), and fine particulate matter (PM).

air zone - is a geographic region that shares the same air quality characteristics. The air zone boundaries may be established considering topographic features, meteorology, economic activities, pollution sources, political boundaries, and common air quality issues.

ambient - surrounding, or on all sides.

biodiversity (biological diversity) - refers to the wealth of life forms on earth, including plants, animals, micro-organisms, the genes they possess and their habitats.

boreal forest - consists of a vegetation type dominated by coniferous trees, especially black and white spruce, balsam fir or larch, interspersed with deciduous trees such as birch and aspen.

carbon sequestration - the provision of long-term storage of carbon in terrestrial or aquatic ecosystems, or underground, so that the buildup of carbon dioxide (a major greenhouse gas) concentration in the atmosphere will be reduced.

carbon sink - an area where the rate of carbon uptake by living organisms exceeds the rate of carbon release.

climate change - an alteration in measured quantities (e.g. precipitation, temperature, radiation, wind, cloudiness) within the climate system, that is significantly different from previous average conditions and is seen to endure - bringing about corresponding changes in ecosystems and socio-economic activity.

condition indicators - represent the health or status of both the structure and services of the environment, and how the structure and services function together.

coniferous - evergreen shrubs and trees characterized by needle-shaped leaves, cones and a resinous wood.

criteria air contaminants (CACs) - emissions of criteria air contaminants contribute to smog, poor air quality and acid rain. CACs include total particulate matter (TPM), particulate matter with a diameter less than 10 microns (PM10), particulate matter with a diameter less than 2.5 microns (PM2.5), carbon monoxide (CO), nitrogen oxides (NOx), sulphur oxides (SOx), volatile organic compounds (VOC), and ammonia (NH3).

deciduous - plants which shed their leaves or needles at a particular season, usually autumn.

ecoregion - broad integrated land area characterized by a unique combination of landscape, physiography and ecoclimate within the Ecological Land Classification (ELC) System.

ecosystem - the interaction of plants, animals, other organisms and non-living components, which function together to circulate nutrients and create a flow of energy.

emissions - polluted gases, particles, or liquids released into the atmosphere.

emission sources -

- open sources: emission sources that emit air contaminants over large geographical areas, primarily in a stationary but non-point source manner, and are diffuse in nature. Examples include dust from farms, construction, and paved and unpaved roads.
- natural sources: emission sources such as biogenic emissions from vegetation, biological and geological sources, and wildfires.

- industrial sources: emissions sources such as mining, upstream oil and gas, petroleum refining, steel production, chemicals, asphalt plants, pulp and paper and grain industries.
- non-industrial sources: emission sources such as power generation utilities, commercial and residential fuel combustion, and residential fuel wood combustion.
- mobile sources: transportation emission sources such as wheeled vehicles, ships, aircraft and railroad locomotives.

evapo-transpiration - the movement of water from the soil and plant communities to the atmosphere by evaporation of water from the soil and transpiration of water by plants.

Forest Management Agreement (FMA) - an agreement entered into by the minister pursuant to The Forest Resources Management Act, where the term of the agreement is not exceed 20 years, with provisions setting out the rights of the licensee for the harvesting of forest products and the responsibilities of the licensee for the renewal of specified forest products.

fugitive emissions - air pollution derived from human activities that do not emanate from a particular point, such as an exhaust pipe or stack. Roadway dust and volatile organic compounds (VOCs) from refinery valves are examples of fugitive emissions.

greenhouse gases - gases such as carbon dioxide, methane, chlorofluorocarbons, nitrous oxide and water vapor that trap heat in the Earth's atmosphere and contribute to global warming.

hectare - one hectare is the equivalent of 10,000 m2 (0.01 km2) or 2.471 acres. A hectare could also be considered the area of slightly less than three Canadian football fields.

indicator - physical, chemical, biological or socio-economic measures used to simplify, describe, monitor and interpret environmental functions.

legislation - the act or process of making laws.

micron - 39.37 millionths of an inch, or 0.001 millimetre.

NSR (Not Sufficiently Regenerated) - is defined as area not meeting regeneration standards.

non-point source - a source of atmospheric, aquatic or terrestrial pollution in which naturally occurring or human-created pollutants are discharged over a widespread area or from a number of small inputs, rather than from one distinct, identifiable source (point source).

particulates - fine liquid or solid particles that remain suspended in the air for any length of time such as dust, smoke, mist, fumes or smog found in the air of emissions. Particulate matter can be broken down into the following categories:

- total particulate matter (TPM): any particulate matter with a diameter less than 100 microns.
- particulate matter less than or equal to 2.5 microns (PM2.5): any particulate matter with a diameter less than or equal to 2.5 microns.
- particulate matter less than or equal to 10 microns (PM10): any particulate matter with a diameter less than or equal to 10 microns.

pH – An expression of the intensity of the basic or acidic condition of a liquid or of soil generally expressed on a scale ranging from 0 to 14 where values below 7 are acidic, 7 is neutral and values above 7 are considered alkaline.

point sources - any stationary source that usually releases emissions through stacks or other emissions sources, for which individual source records are maintained in the inventory and for which annual emissions exceed a specified cut-off level.

policy - a defined course of action adopted by an organization or government.

Provincial Forest - any Crown resource land designated by the Minister pursuant to section 12 of The Forest Resources Management Act.

response indicators - represent the management activities implemented to mitigate the stress and improve the health of the environment

riparian - transition zones between land and water environments pertaining to anything connected with, or immediately adjacent to, the banks of a lake, river or other body of water.

seral stages - A broad range of forest stand ages across landscapes. Seral-stage communities consist of vegetation types that are adapted to the site's particular set of physical and biotic conditions. In the unmanaged forested landscape, various natural disturbance agents (such as fire, windthrow, landslides, and insects) are responsible for creating forests containing a full range of stand ages.

species - a group of individuals that share certain physical characteristics and are capable of producing fertile offspring.

- endangered: species on the verge of immediate extinction or extirpation.
- extinct: species that no longer exist anywhere.
- extirpated: species no longer found in the wild in Canada, although they may exist elsewhere.
- threatened: species likely to become endangered if the pressures from human or natural causes threatening them are not reversed.
- vulnerable: species at risk because of low numbers or restricted range; although not in immediate danger, they could be at any time.

stakeholders - the people or groups with a direct or indirect interest, or "stake," in an issue.

stewardship - judicious use and care of the Earth's resources.

strategy - an action plan designed to achieve a specific goal.

stressor indicators - represent human activities that have the potential to impact the health or condition of the environment.

summerfallow - land that has no crop for one year and is either tilled or chemically treated to control weeds.

tillage - mechanical preparation of the soil for seeding, fallow or weed control.

Timber Supply Licence (TSL) - a licence granted by the minister pursuant to The Forest Resources Management Act conferring the right to harvest specified forest products for a set number of years.

Water Quality Index (WQI) - an index used to measure and summarize how well individual water bodies meet surface water quality objectives.

watershed - a geographic area defined by topographic elevation divides that has a common outlet for its surface runoff.

zero-tillage - a one-pass operation that places seed and fertilizer into an undisturbed seedbed, packs the furrow and retains adequate surface residues to prevent soil erosion.